[redacted]

Benjamin Milwitzky

(NASA-CR-95740) SURVEYOR SPACECRAFT SYSTEM (Hughes Aircraft Co.) 74 p

N79-76259

Unclas
00/15 11084

FF No. 60 CR 95740 (NASA CR OR TMX OR AD NUMBER) [redacted]

[redacted] APPLICATION CHANGE

To DS-GP-4
By authority of Shirley Date 10-75
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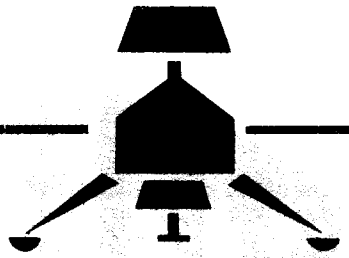
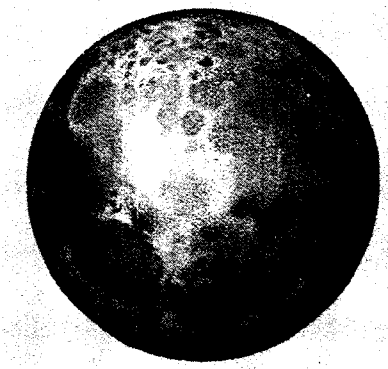


JPL 950056

SURVEYOR SPACECRAFT SYSTEM [U]



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ON 24 JULY 1963

HUGHES

SURVEYOR SPACECRAFT LABORATORY

HUGHES AIRCRAFT COMPANY
EL SEGUNDO, CALIFORNIA

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29 JULY 1963
SSD 3457B

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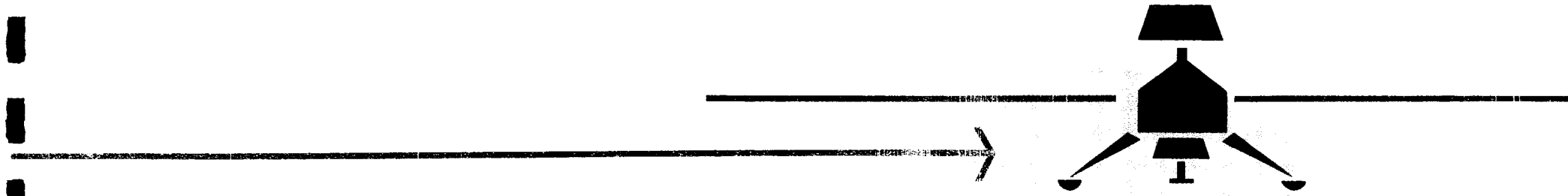
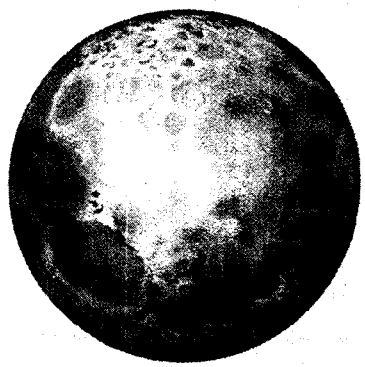


JPL 950056

SURVEYOR SPACECRAFT SYSTEM



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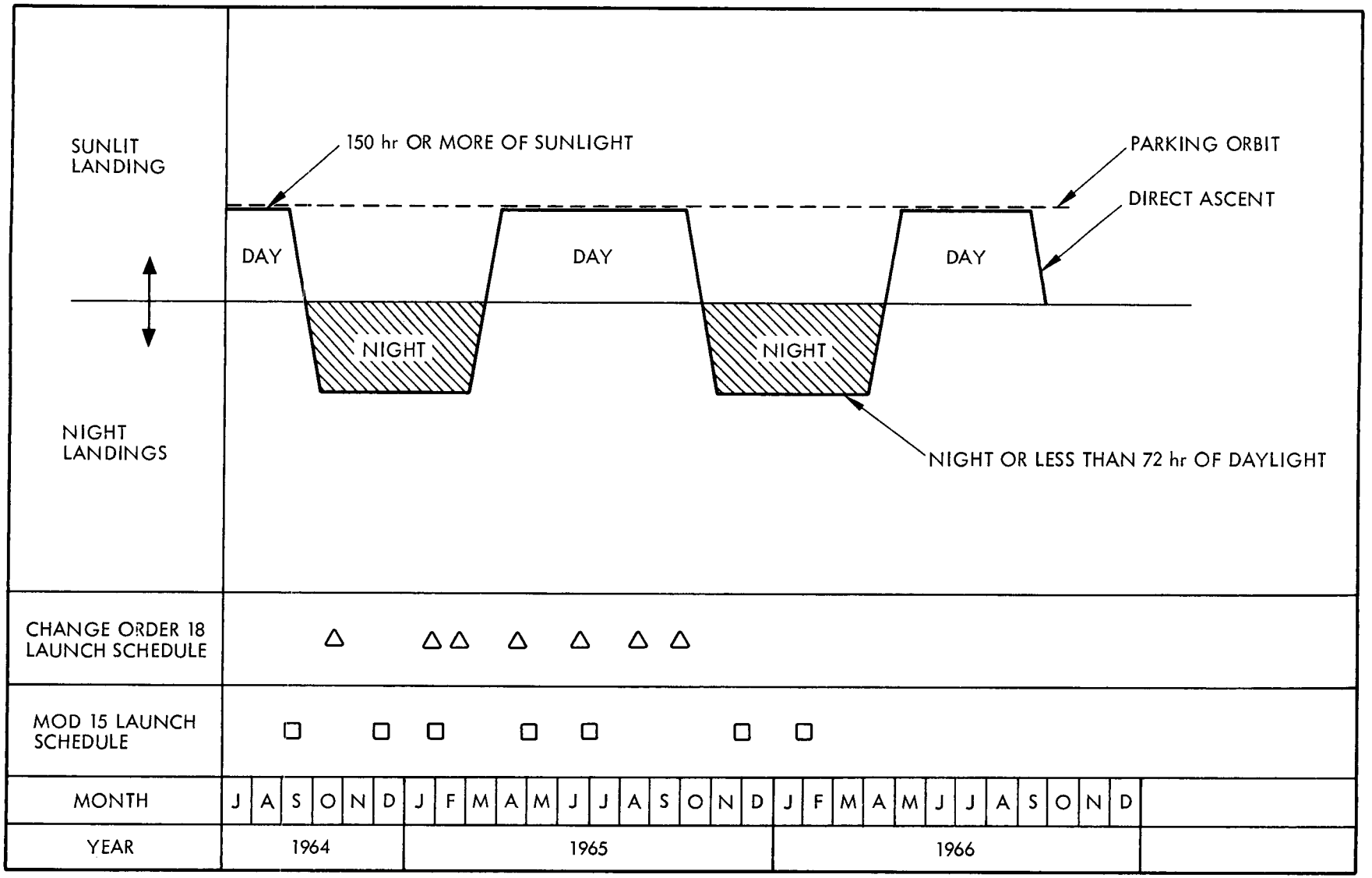
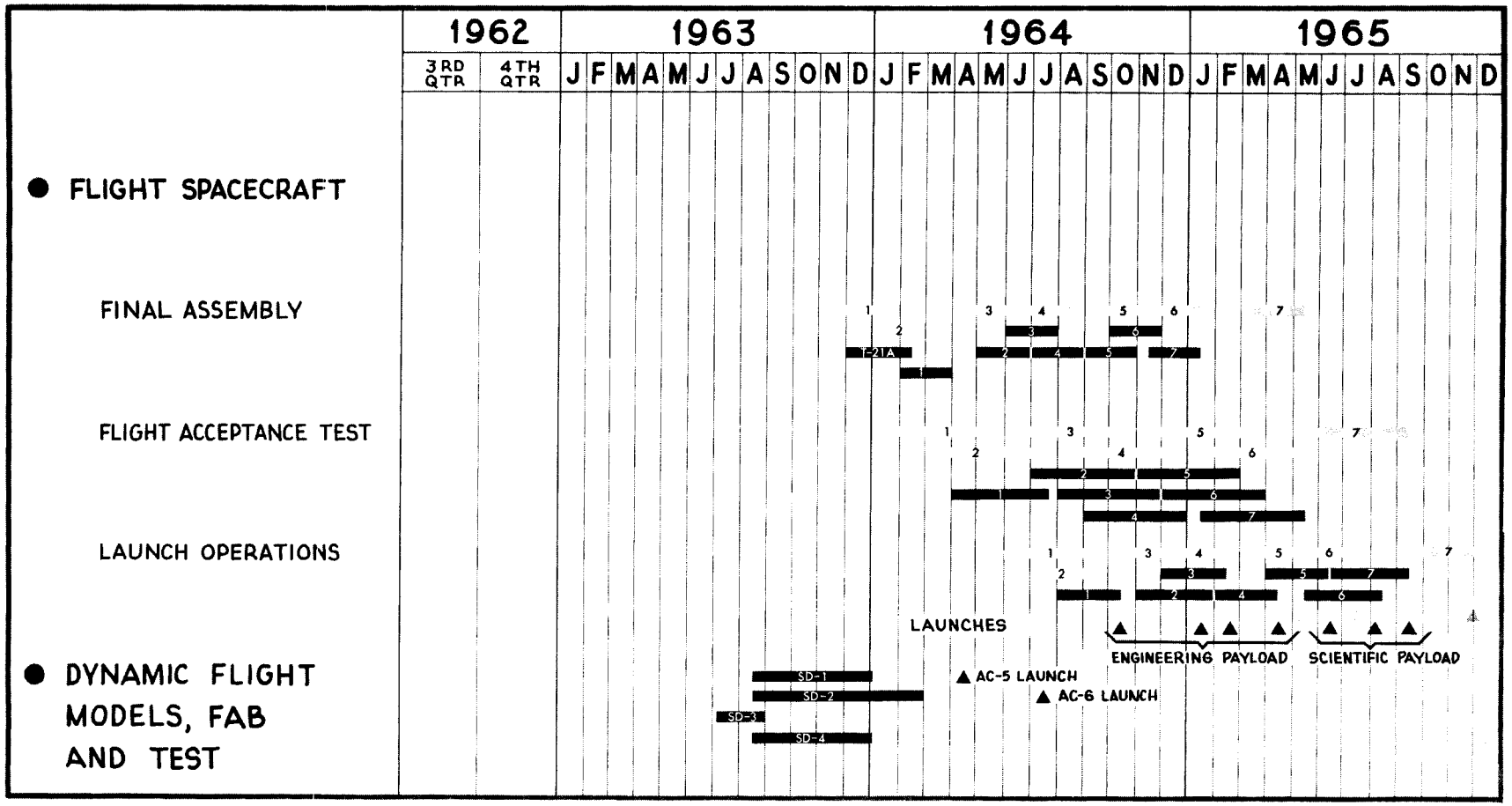
EFFECT OF CENTAUR DIRECT ASCENT TRAJECTORY ON LUNAR ARRIVAL LIGHTING



PROGRAM PLAN-
CHANGE ORDER 18

HUGHES
HUGHES AIRCRAFT COMPANY
SPACE SYSTEMS DIVISION

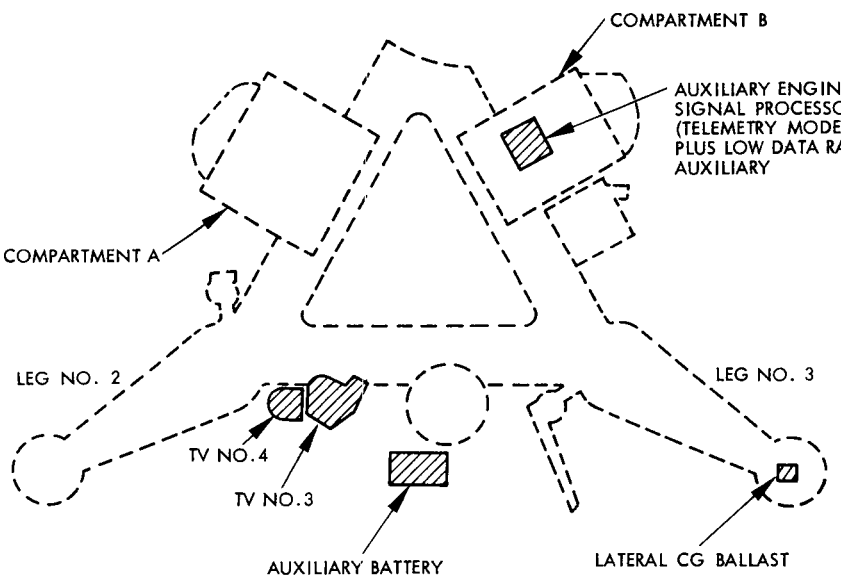
FLIGHT PHASE



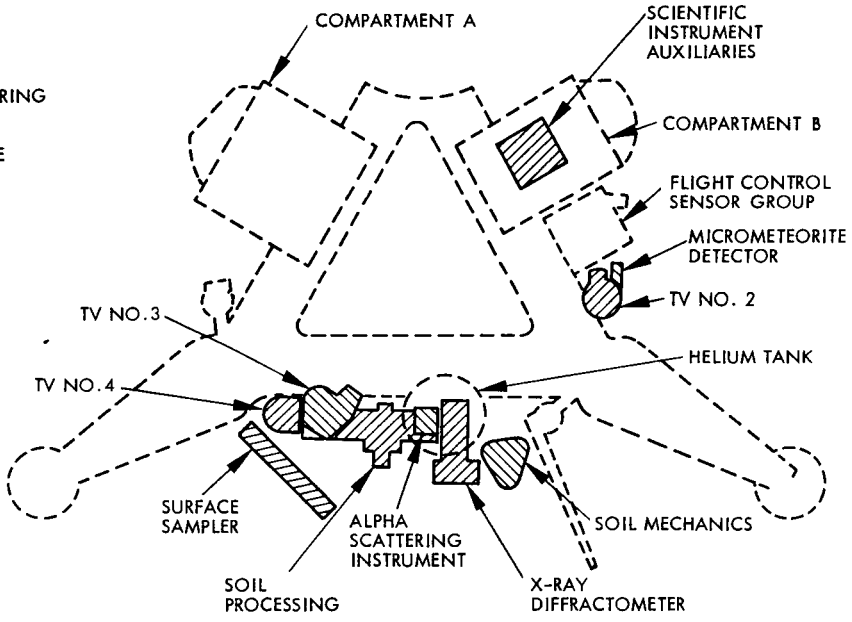
PAYLOAD ELEMENTS
CHANGE ORDER 18

SC-5 TO SC-7 AND T-21A (SAME AS MOD. 15)	WEIGHT, lb	WEIGHT, lb	SC-1 TO SC-4 AND T-21
1 TV NO. 4 - APPROACH (INCLUDING AUXILIARIES)	9.7*	9.7*	TV NO. 4 - APPROACH
2 TV NO. 3 - SURVEILLANCE (INCLUDING AUXILIARIES AND CALIBRATION CHART)	21.4*	21.4*	TV NO. 3 - SURVEILLANCE
3 TV NO. 2 - SURVEILLANCE	17.4	31.3*	AUXILIARY BATTERY AND CONTROL
4 SURFACE SAMPLER	10.6	0.5*	LOW DATA RATE AUXILIARY
5 SOIL PROCESSOR	13.6	6.0*	AUXILIARY ENGINEERING SIGNAL PROCESSOR (TELEMETRY MODE NO. 5)
6 X-RAY DIFFRACTOMETER	17.0	4.2*	ENGINEERING INSTRUMENTATION (SUPPLEMENT NO. 1)
7 ALPHA SCATTERING INSTRUMENT	7.8	4.5*	ENGINEERING INSTRUMENTATION (SUPPLEMENT NO. 2)
8 SOIL MECHANICS INSTRUMENT	14.8	3.0	LATERAL CG BALLAST
9 MICROMETEORITE EJECTA DETECTOR	3.5	11.5	VERNIER FUEL RESERVE
10 PAYLOAD WIRING HARNESS (ITEMS 3 TO 9)	11.8		
11 ENGINEERING INSTRUMENTATION (SUPPLEMENT NO. 1)	4.2*		
12	2.0	2.0	MAIN RETRO FUEL INCREASE (CENTAUR DIRECT ASCENT EFFECT)
*INCLUDES WIRING HARNESS TOTAL	133.8	94.1	

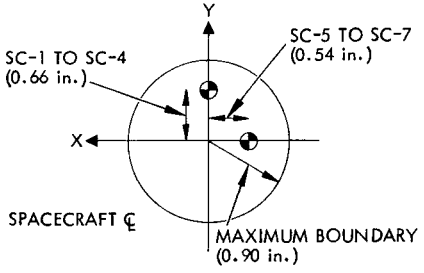
PAYLOAD CONFIGURATIONS



SC-1 THROUGH SC-4
(ENGINEERING)

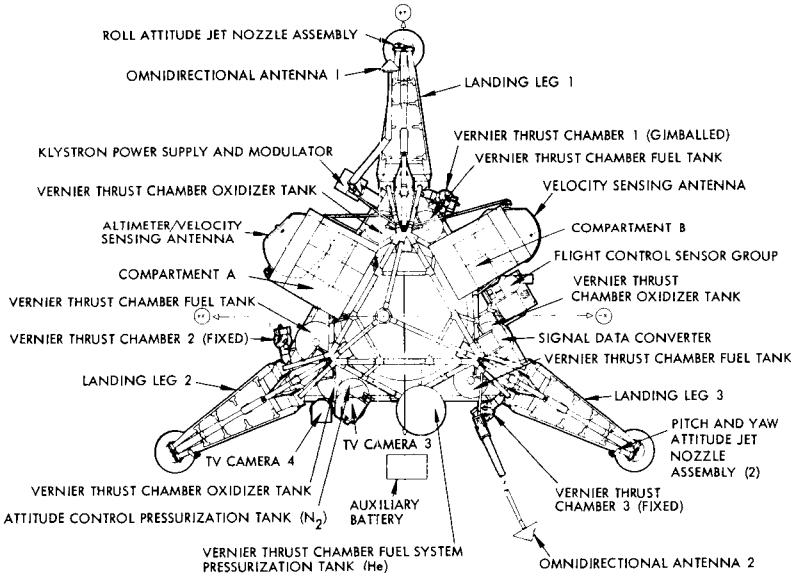


SC-5 THROUGH SC-7
(SCIENTIFIC)

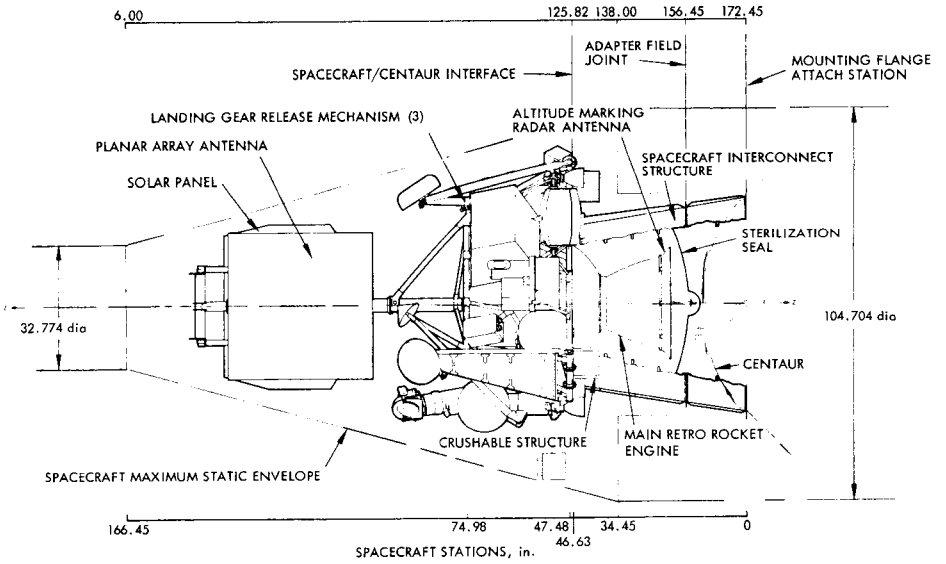


LATERAL CENTER OF GRAVITY

CONFIGURATION FOR SC-5 THROUGH SC-7



MIDCOURSE CONFIGURATION



STOWED CONFIGURATION

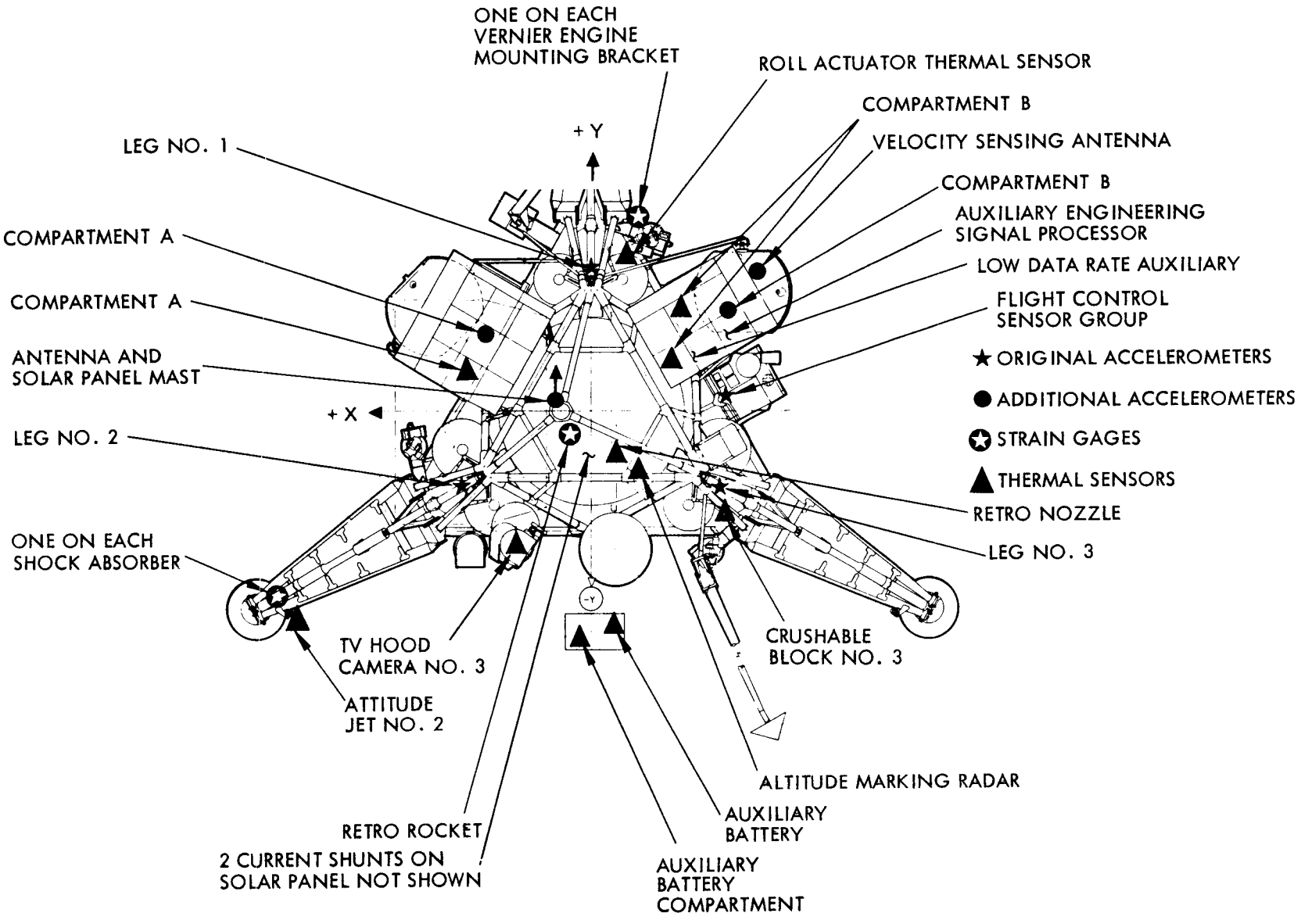
SPACECRAFT WEIGHT AND BALANCE SUMMARY
CHANGE ORDER 18

ITEM	T-21 AND SC-1 THROUGH SC-4	T-21A AND SC-5 THROUGH SC-7	PREVIOUS REPORT JAN. 1963
● BASIC BUS* (LESS TV NO. 4), lb	658.0	658.0	645
● USABLE FUEL* (STANDARD LOAD FOR 2100 lb SEPARATED WEIGHT), lb	1347.7	1347.7	1348
● PAYLOAD, lb*	94.1	133.8	136
● TOTAL SPACECRAFT WEIGHT, lb*	2099.8	2139.5	2129
● LATERAL cg (WITHOUT MAIN RETRO), in.			
r	0.66	0.54	
r (MAXIMUM ALLOWABLE)	0.9	0.9	
● PLANNED WEIGHT REDUCTIONS, lb	8	4	
FLIGHT CONTROL PROGRAMMER	2	2	
VERNIER FUEL I_{sp}	1	1	
ANTENNA/SOLAR PANEL SUPPORT MATERIAL CHANGE	1	1	
FIXED ANTENNA/SOLAR PANEL MAST	4		
*NOT INCLUDING PLANNED WEIGHT REDUCTIONS			

ENGINEERING INSTRUMENTATION SUMMARY

	CONTRACT PHASE / DATE			
	MOD. 6/JUN 1961	MOD. 15/OCT 1962	CHANGE ORDER 18/MAY 1963	
	ALLOCATION			
	BASIC BUS	PAYLOAD		
		SUPPLEMENT NO. 1	SUPPLEMENT NO. 2	
	WEIGHT (INCLUDING WIRING)			TOTAL
SUBSYSTEM	9.2	4.2	4.5	17.9
SPACECRAFT VEHICLE AND MECHANISMS	• LANDING GEAR: POSITION → STRAIN GAUGE ON SHOCK STRUT • SPACE FRAME: ACCELEROMETERS (4) • OMNI-ANTENNA: POSITION • PLANAR ANTENNA: POSITION • SOLAR PANEL: POSITION • RETRO ENGINE: SEPARATION SENSOR • THERMAL (6) → (12) → (5)		• COMPARTMENT: ACCELEROMETER (2) • MAST: ACCELEROMETER (1)	
PROPULSION	• VERNIER: H_e TANK PRESSURE → FUEL MANIFOLD PRESSURE → STRAIN GAUGE ON ATTACH BRACKET • MAIN RETRO: STRAIN GAUGE ON CASE • THERMAL (7) → (8) → (1)			
FLIGHT CONTROL (ϵ = ERROR SIGNAL)	• GYROS: ϵ, WHEEL SPEED, PRECESSION DIRECTION • SUN SENSORS: ϵ, LOCK ON • CANOPUS SENSOR: ϵ, INTENSITY, LOCK ON → SECONDARY SUN SENSOR LOCK ON • ACCELEROMETER: ϵ, AND MAGNITUDE • PROGRAMMER: RETRO IGNITION, RETRO EJECT, GYRO PRECISION SIGNAL, SWITCHING STATE (8), VERNIER THRUST SIGNAL → THRUST PHASE POWER ON, VERNIER ENGINE IGNITION SIGNAL, SWITCHING STATE (3) • GAS JETS: SUPPLY PRESSURE • RADVS: RANGE AND VELOCITY, AMPLITUDE, MARK SIGNAL AT 10 FPS, 1000 ft AND 13 ft → DOPPLER BEAM RELIABLE SIGNAL, RANGE AND DOPPLER GAIN → ANTENNA ACCELEROMETER • ALT. MARK. RADAR: RADAR ON, AGC → ENABLE VERIFICATION AND MAGNETRON CURRENT • THERMAL (8) → (5) → (3)	• ROLL ACTUATOR: INPUT SIGNAL		
ELECTRIC POWER	• SOLAR PANEL: VOLTAGE, CURRENT, AND TEMPERATURE → LOCK, CURRENT, BACK PANEL TEMPERATURE • BATTERY: VOLTAGE, CURRENT, AND TEMPERATURE • CENTRAL POWER CONTROL: REGULATOR VOLTAGE → CHARGE REGULATOR AND BUS CURRENTS			
TELECOMMUNICATIONS	• TRANSMITTERS: FILAMENT ON → POWER OUTPUT • RECEIVER: AGC → AFC • TRANSPONDER: PHASE LOCK AND ERROR • CENTRAL DECODER: STATE, MESSAGE REJECT AND ENABLE • SIGNAL PROCESSOR: REFERENCE VOLTAGE AND RETURN • THERMAL (2)			
T.V. NO. 4	• POWER: ON SIGNAL • VIDICON: THERMAL CONTROL ON SIGNAL • THERMAL (2)			

ENGINEERING PAYLOAD SENSORS
SC-1 THROUGH SC-4



FAILURE MODE STUDY SCHEDULE

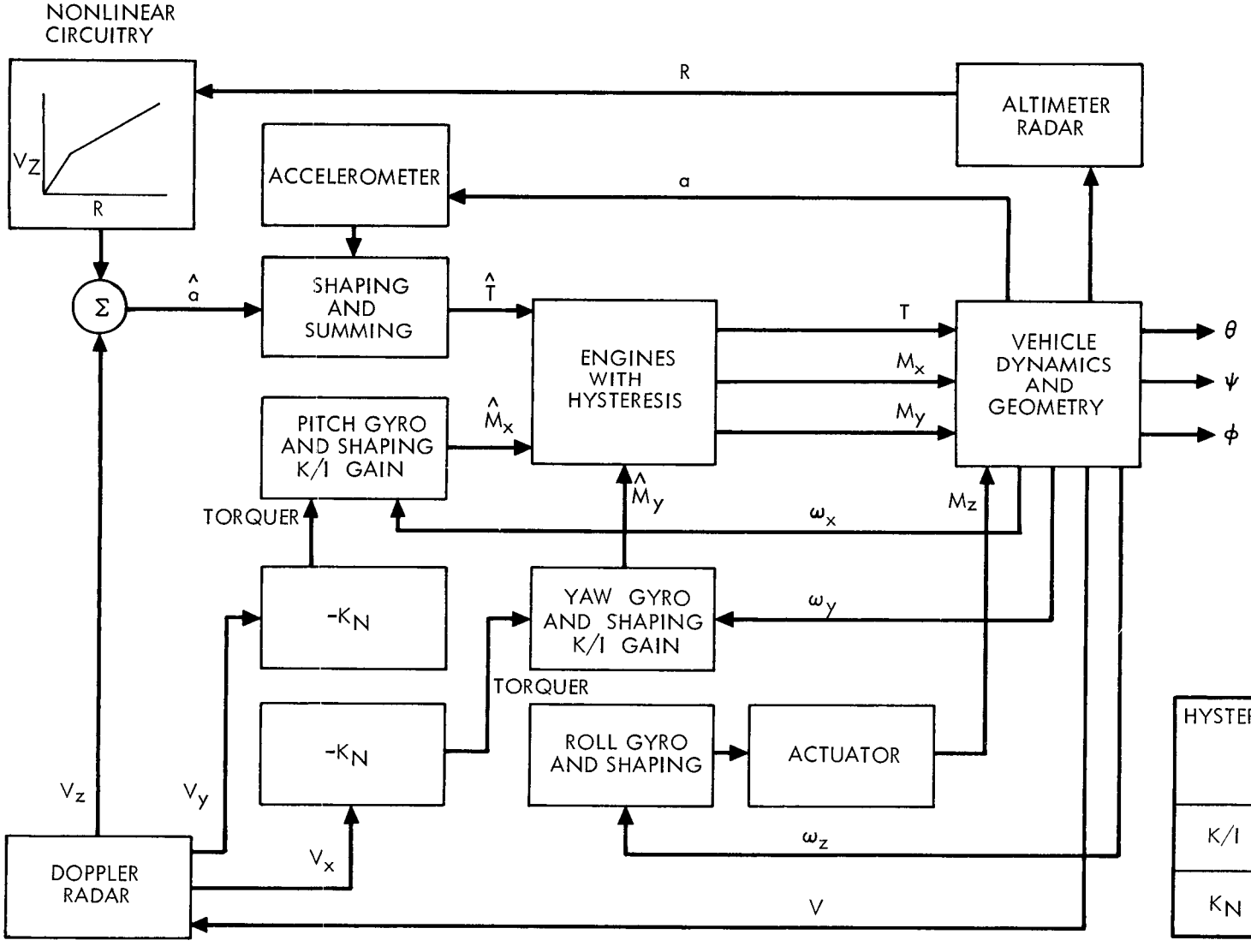
NONSTANDARD PROCEDURE	COMPLETION DATE 1963												DESIGN IMPLICATIONS OR CHANGES EFFECTED
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
CANOPUS SENSOR	▲												CANOPUS LOCKON LOGIC CHANGE
SOLAR PANEL POSITIONING	▲												SOLAR PANEL LOCK TELEMETRY REQUESTED
SOLAR PANEL ELECTRICAL	▲												
PRIMARY AND SECONDARY SUN SENSOR		▲											SUN LOCKON SIGNAL TELEMETRY REQUESTED
LANDING GEAR MECHANISM		▲											OMNIDIRECTIONAL ANTENNA EXTENSION MECHANIZATION CHANGE REQUESTED
OMNI-ANTENNA MECHANISM AND ELECTRONICS		▲											
FLIGHT CONTROL-COAST PHASE			▲										FLIGHT CONTROL PROGRAMMER REDESIGN
ONE-WAY ACQUISITION			▲										
TWO-WAY ACQUISITION				▲									
PRETHRUST ATTITUDE MANEUVER					▲								
FLIGHT CONTROL-THRUST PHASE					▲								
STANDARD ATTITUDE MANEUVER					▲								
COMMAND/TRANSPONDER SYSTEM						▲							
TERMINAL DESCENT							▲						INCORPORATED MANUAL RETRO IGNITION AND SEPARATION
PLANAR ARRAY ORIENTATION AND DESCENT TV							△						
POWER MANAGEMENT								△					
EMERGENCY RETRO SEQUENCE								△					
CENTAUR SEPARATION									△				
SOLAR PANEL NOT IN TRANSIT POSITION										△			
COAST PHASE ROLL CONTROL											△		
CONSERVATION OF BATTERY ENERGY												△	
PLANAR ARRAY AS ROLL ATTITUDE REFERENCE												△	
FLIGHT CONTROL PROGRAMMER												△	

▲ COMPLETED

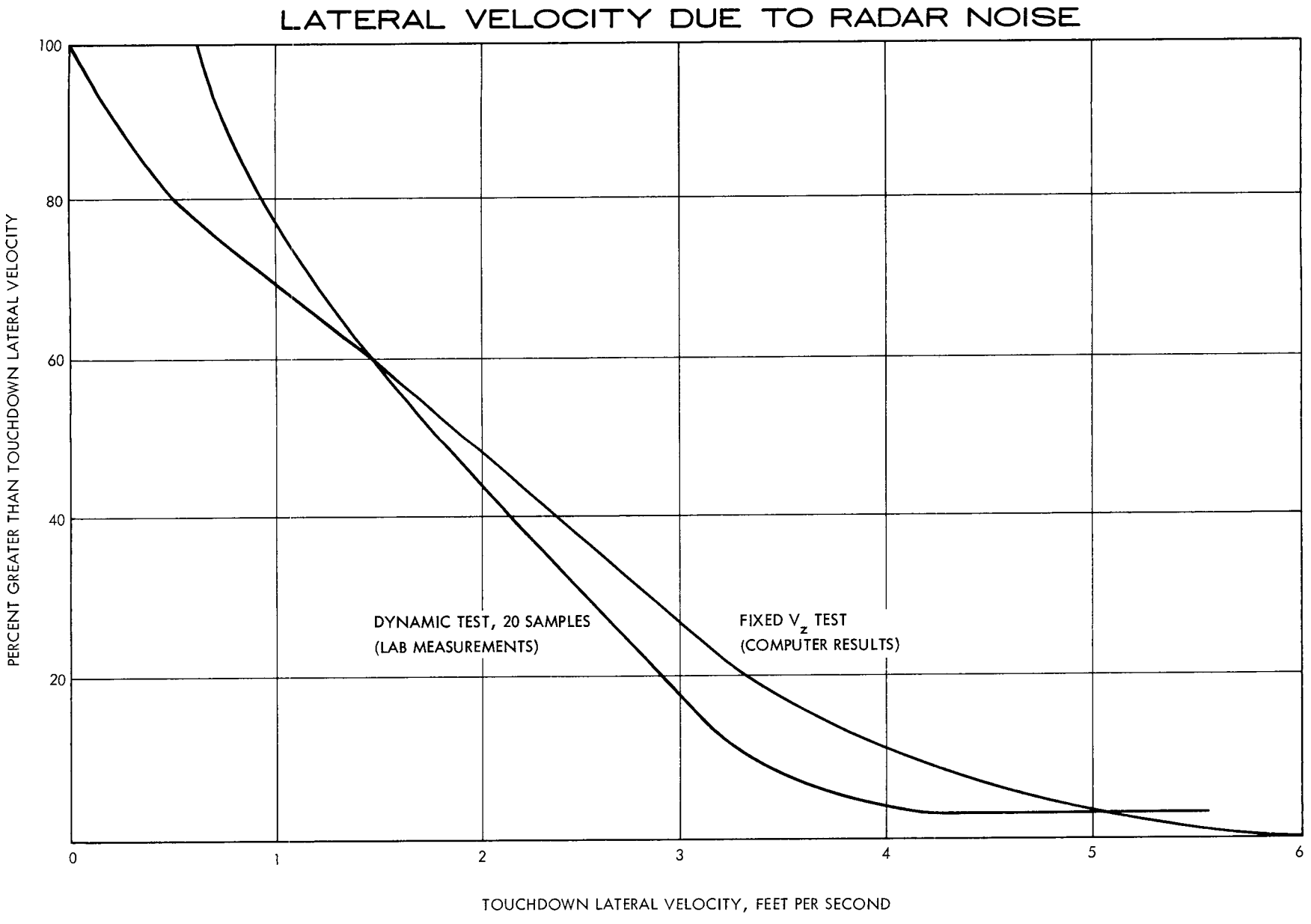
△ PLANNED

CONTROL SYSTEM BLOCK DIAGRAM

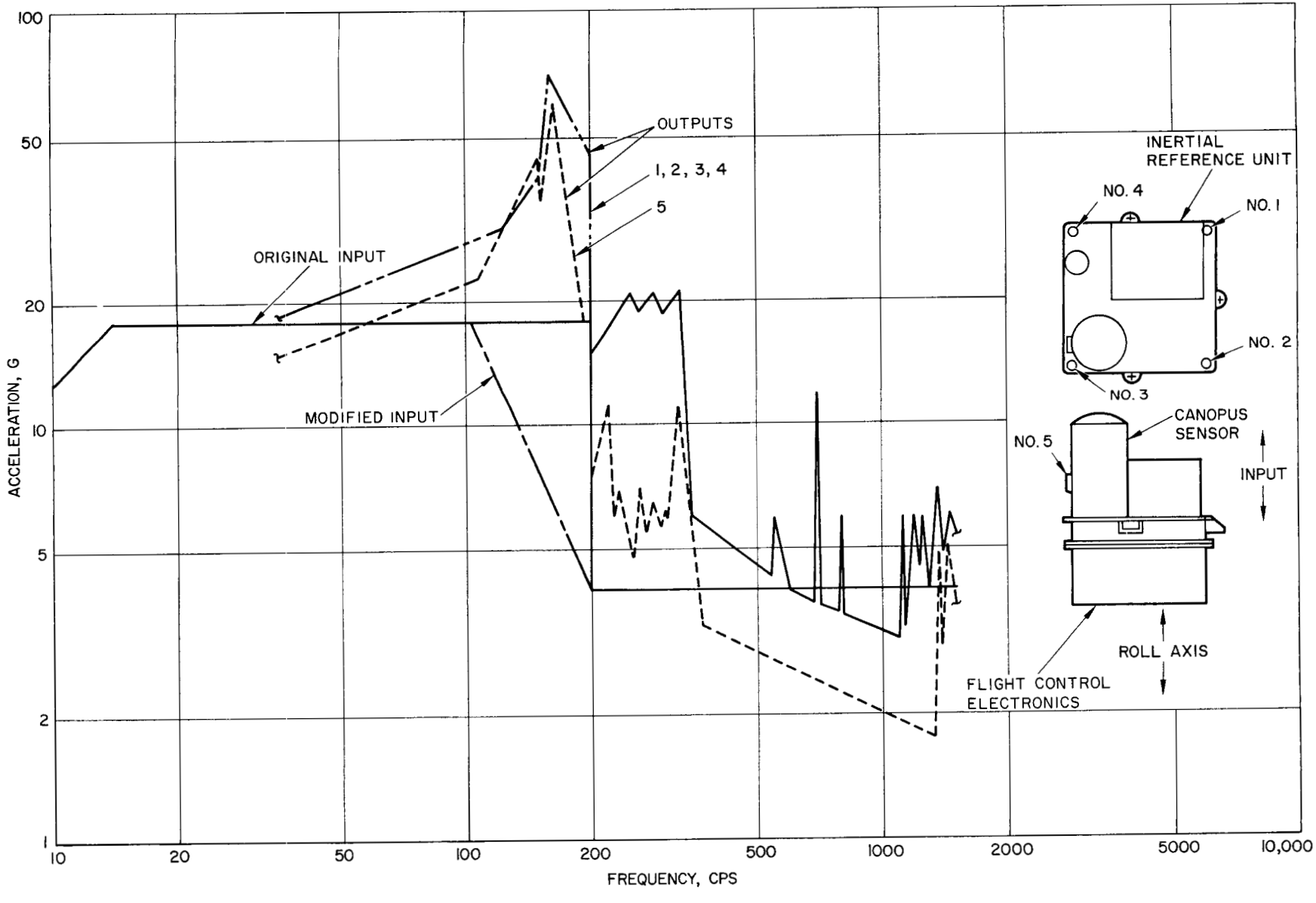
SIX DEGREE OF FREEDOM WITH HYSTERESIS



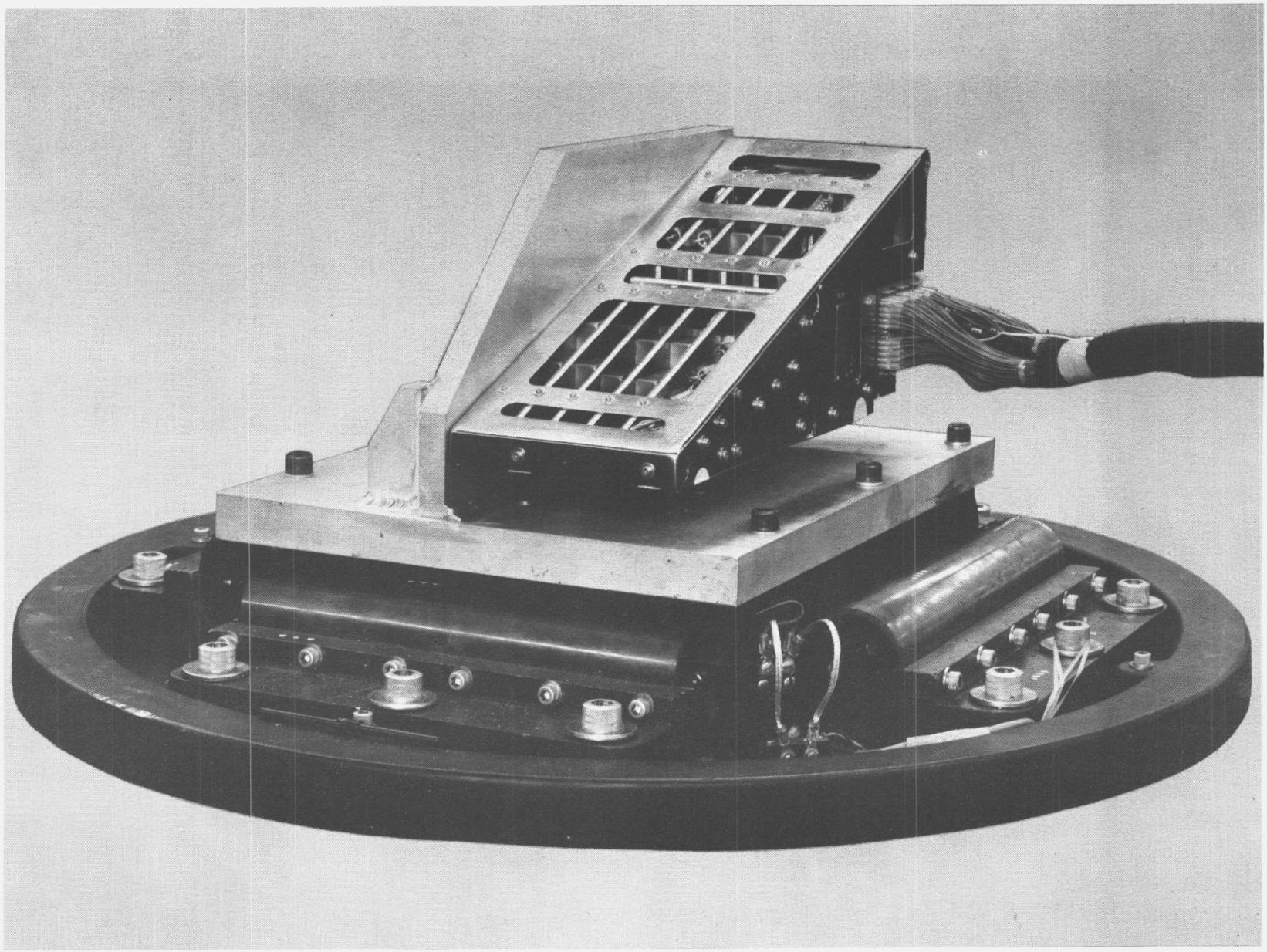
HYSTERESIS COMPENSATION		
	PAST	PRESENT
K/I	12	27
K_N	0.012	0.017


LATERAL VELOCITY DUE TO RADAR NOISE
PERCENT GREATER THAN TOUCHDOWN LATERAL VELOCITY
100
80
60
40
20
0
1
2
3
4
5
6
DYNAMIC TEST, 20 SAMPLES
(LAB MEASUREMENTS)
FIXED V_z TEST
(COMPUTER RESULTS)
TOUCHDOWN LATERAL VELOCITY, FEET PER SECOND

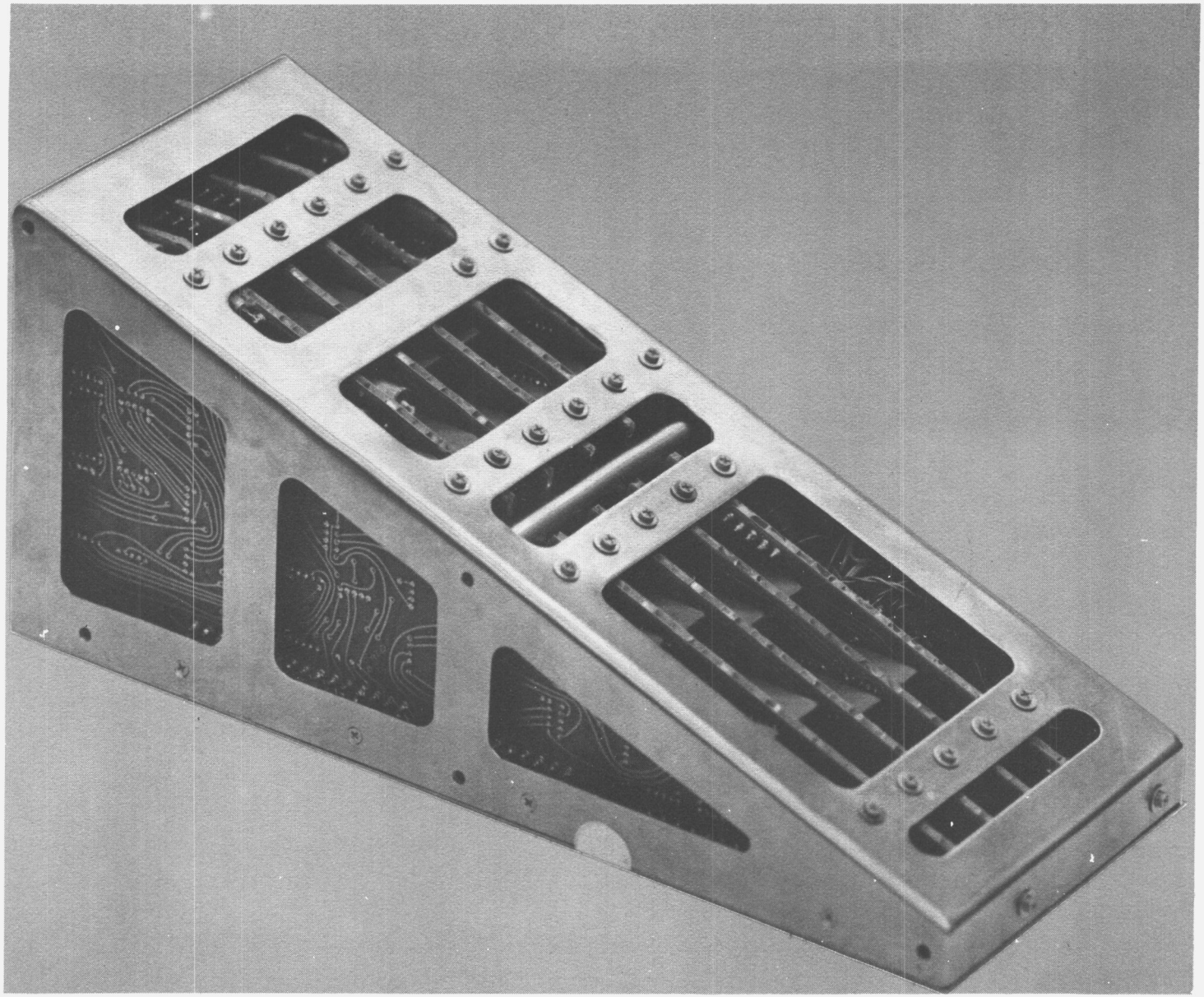
VIBRATION TESTING OF FLIGHT CONTROL SENSOR GROUP



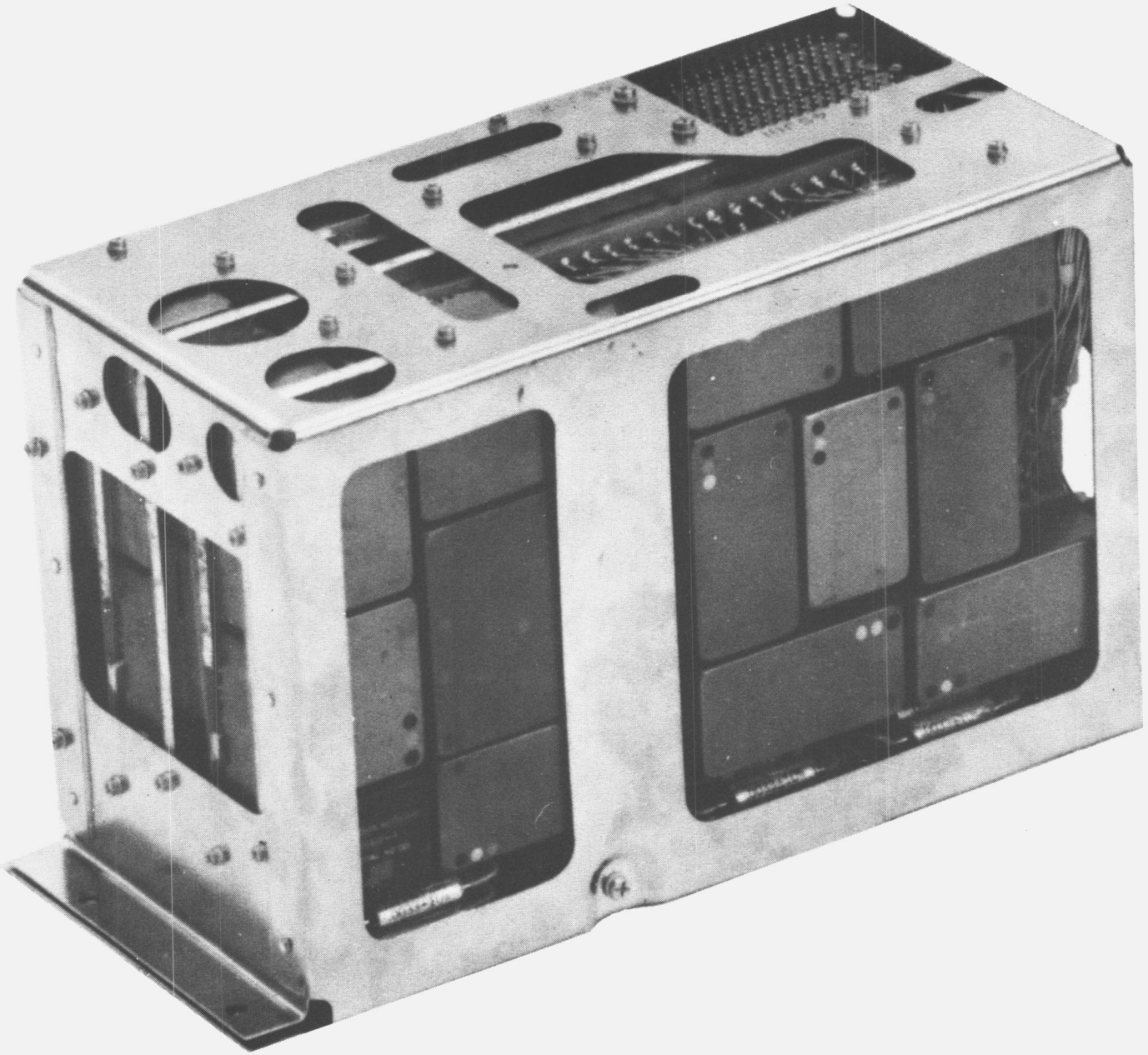
CENTRAL COMMAND DECODER IN VIBRATION TEST SETUP



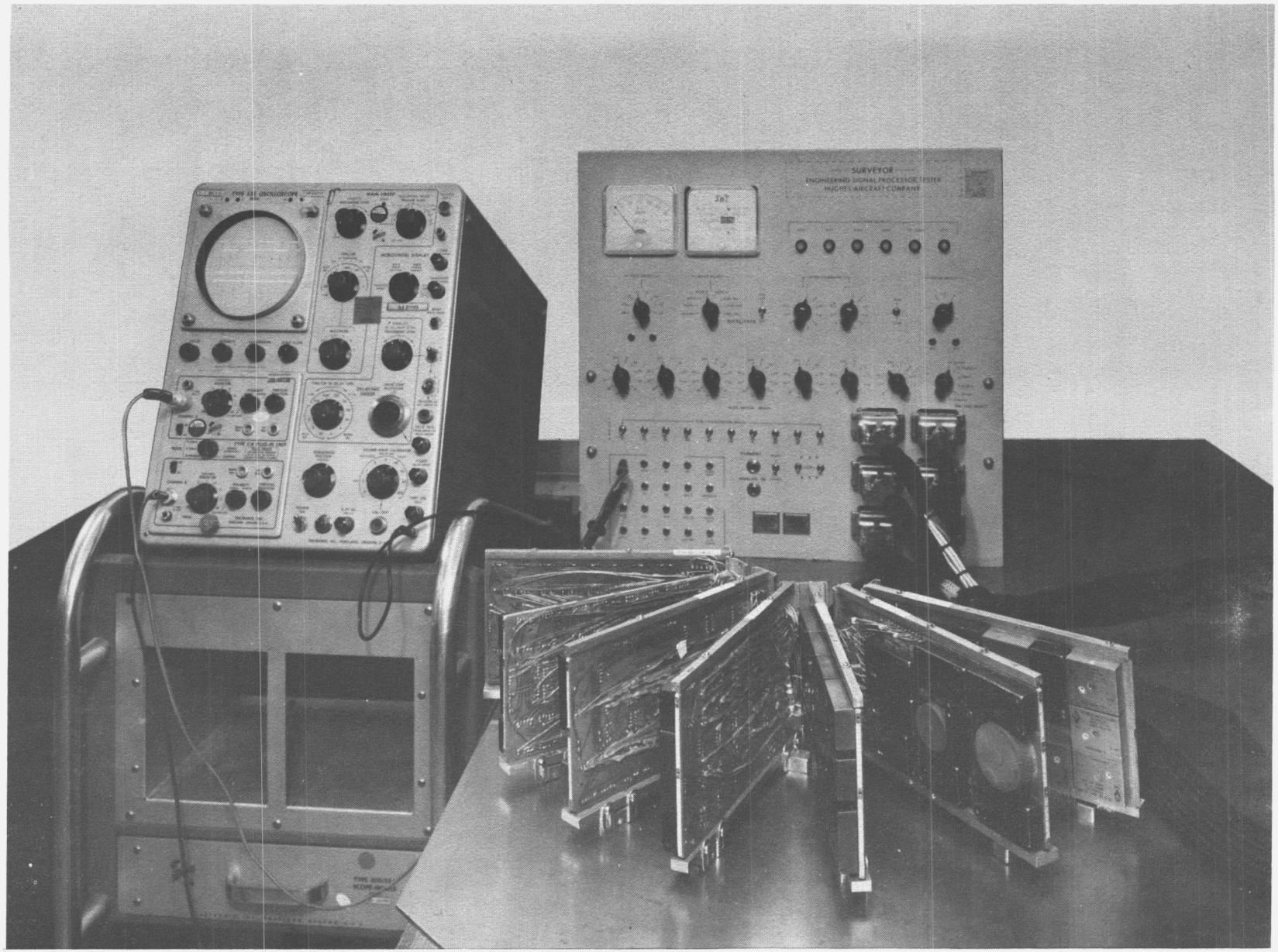
CENTRAL COMMAND DECODER



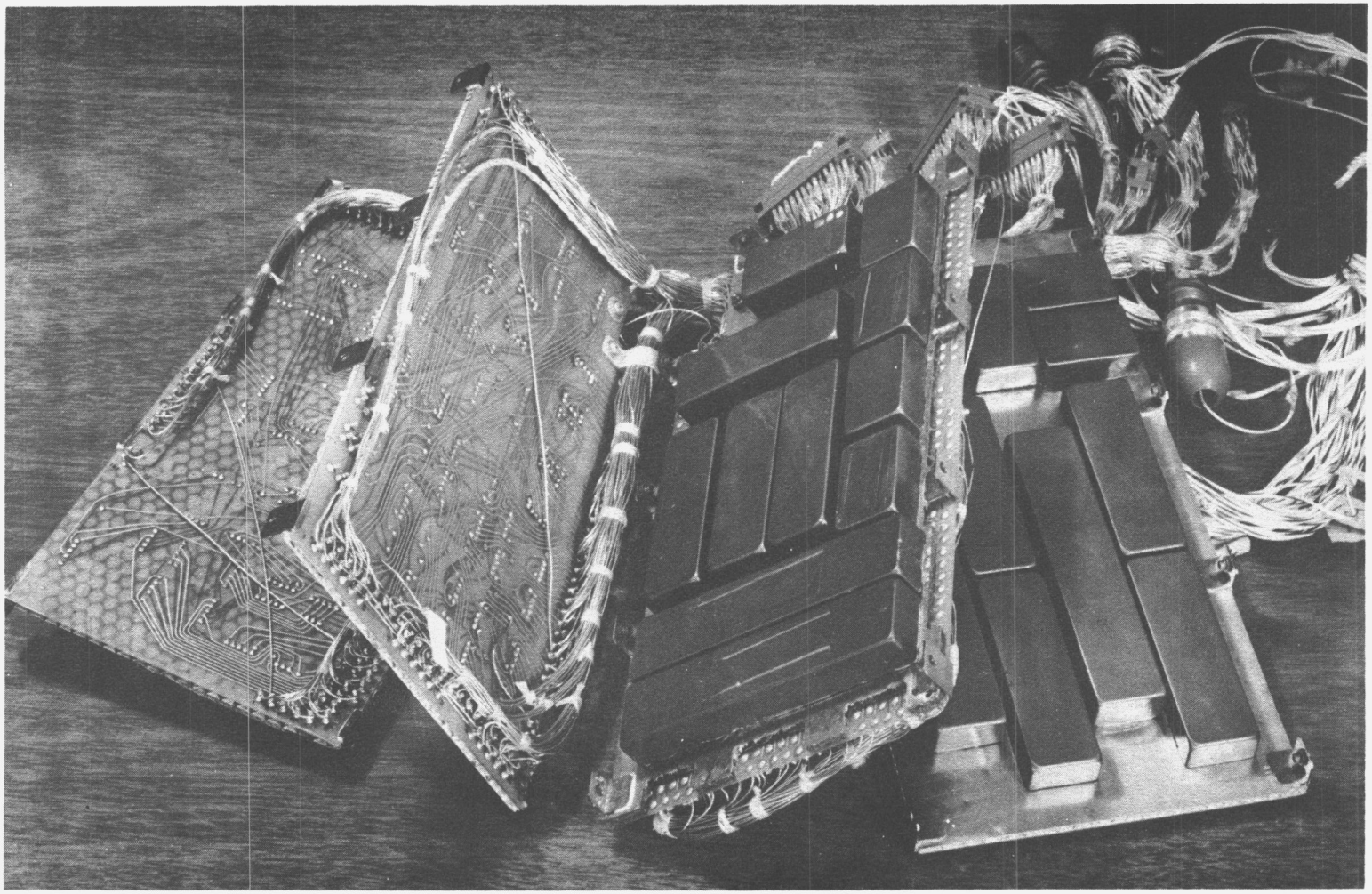
CENTRAL SIGNAL PROCESSOR



ENGINEERING SIGNAL PROCESSOR

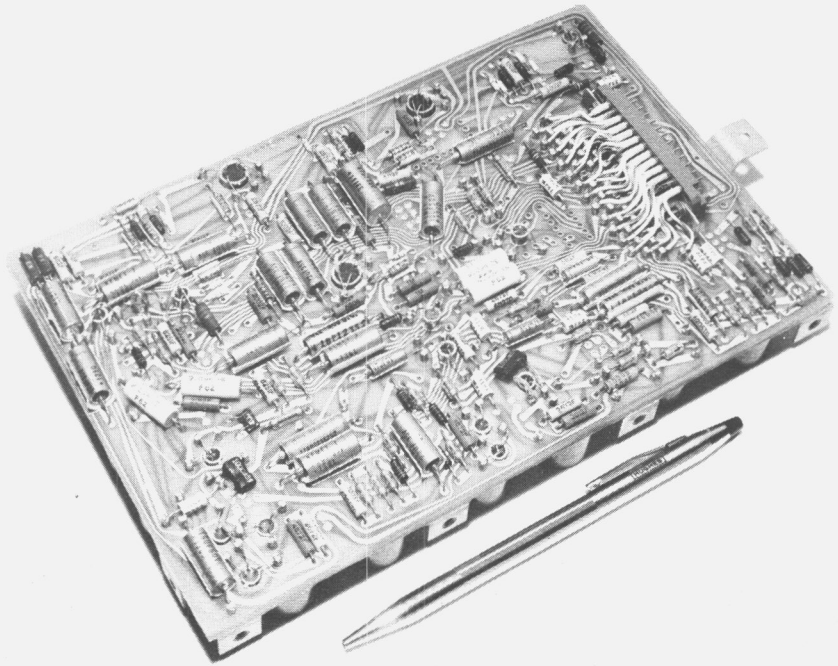


T-21 FLIGHT CONTROL PROGRAMMER

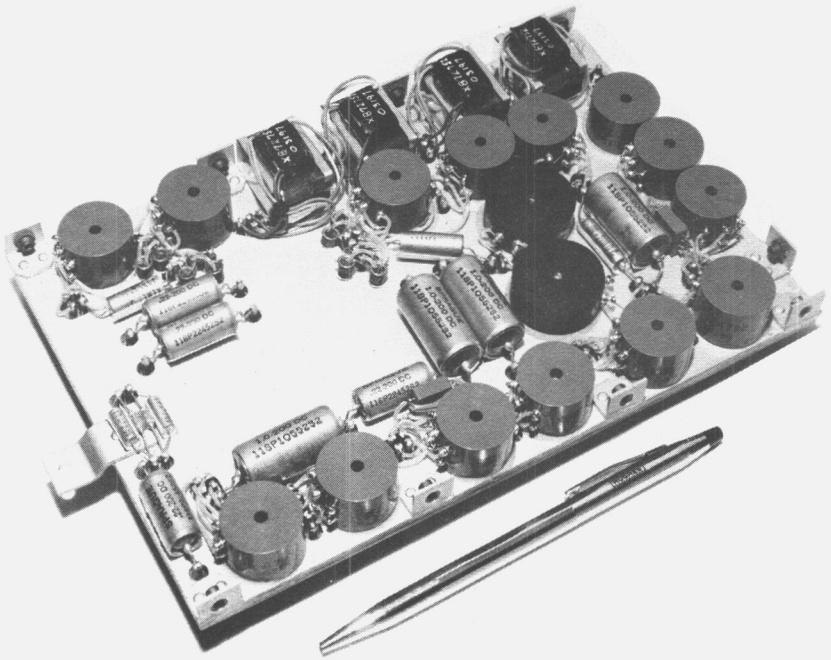


SANDWICH CHASSIS FROM FLIGHT CONTROL ELECTRONICS

COMPONENTS BONDED WITH EPOXY RESIN

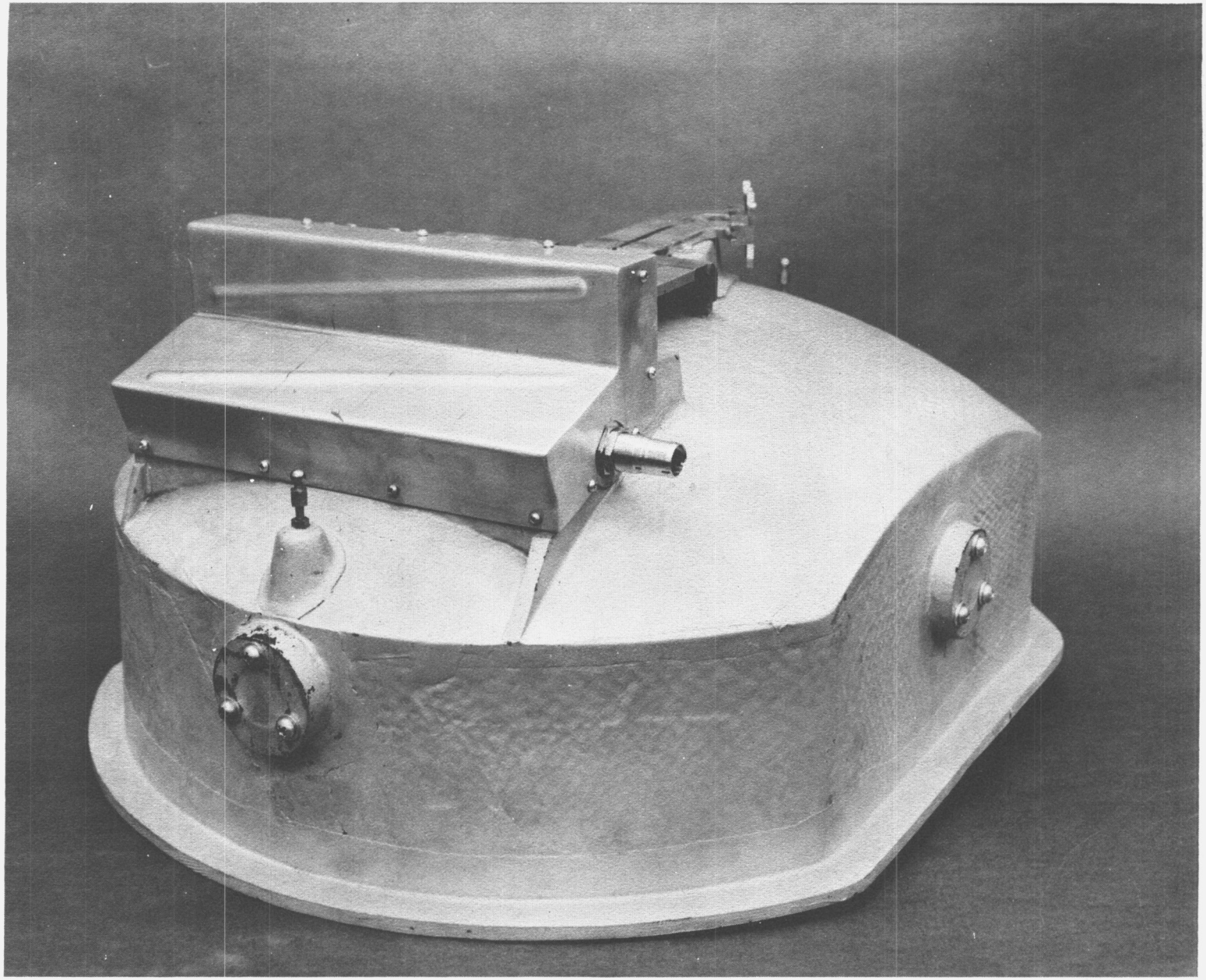


TOP



BOTTOM

MODIFIED RADVS ANTENNA DISH AND ELECTRONICS



T-21 SOLAR PANEL PERFORMANCE AT TABLE MOUNTAIN

TEST RUN NO.	ACTUAL POWER OUTPUT, WATTS	AVERAGE TEST TEMPERATURE, °C	POWER OUTPUT* CORRECTED, WATTS	REQUIRED POWER OUTPUT,* WATTS
1	78.9	57.6	83.8	79.2
2	78.1	60.1	84.2	79.2
3	78.9	57.9	82.9	79.2
4	79.2	55.8	82.5	79.2
5	79.5	56.4	83.0	79.2

AVERAGE POWER = 83.3 w

STANDARD DEVIATION = 0.6 w

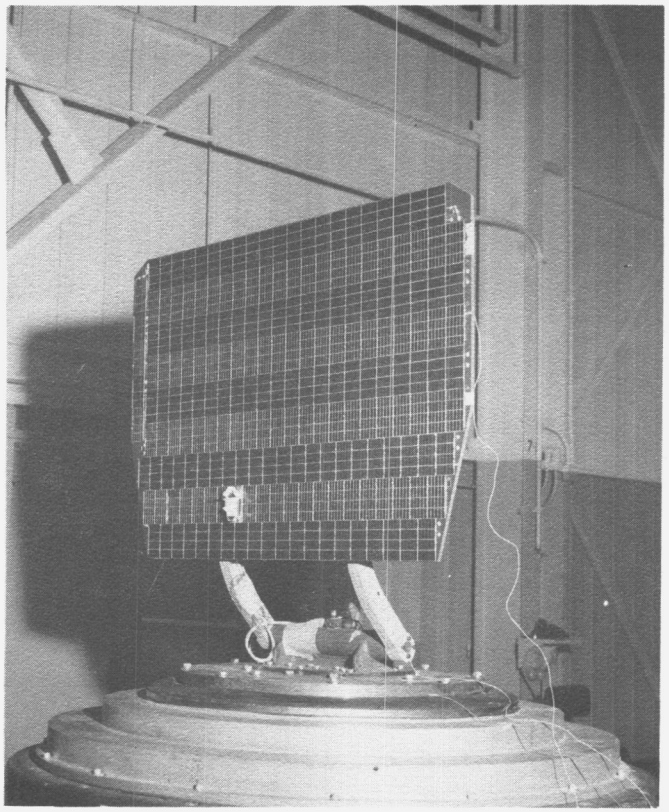
*AT STANDARD TEST CONDITIONS:

INTENSITY = 100 mw/cm^2

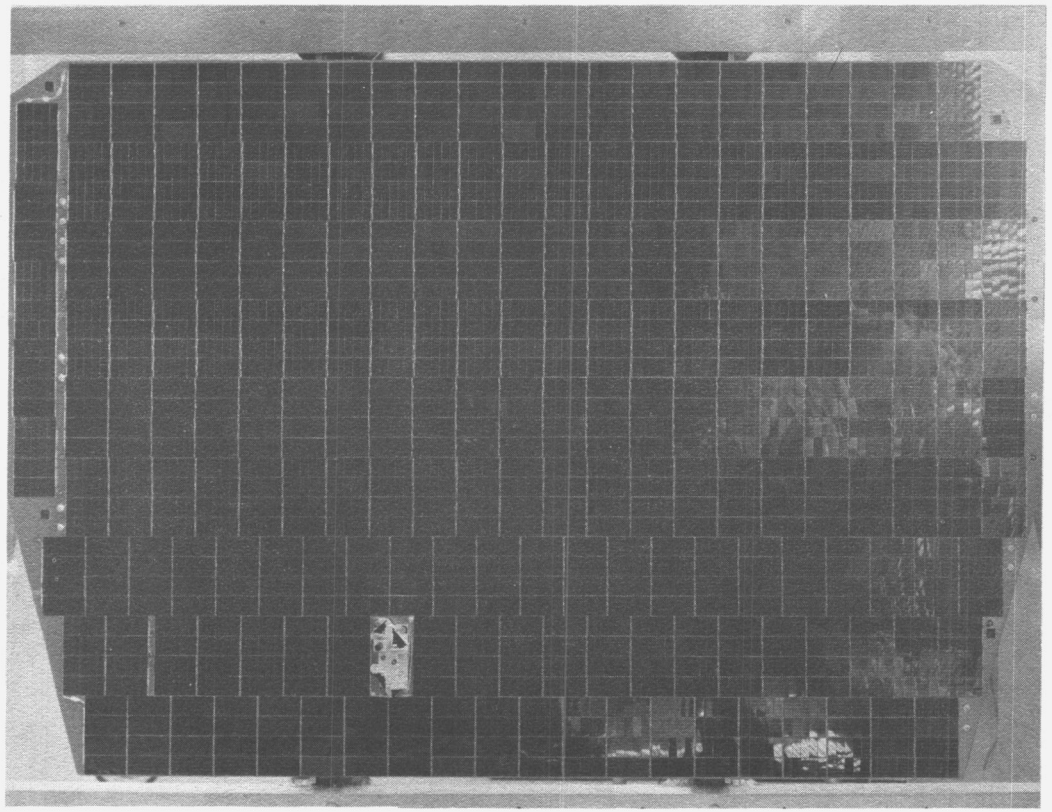
TEMPERATURE = 25°C

VOLTAGE = 51.8

T-21 SOLAR PANEL VIBRATION TEST

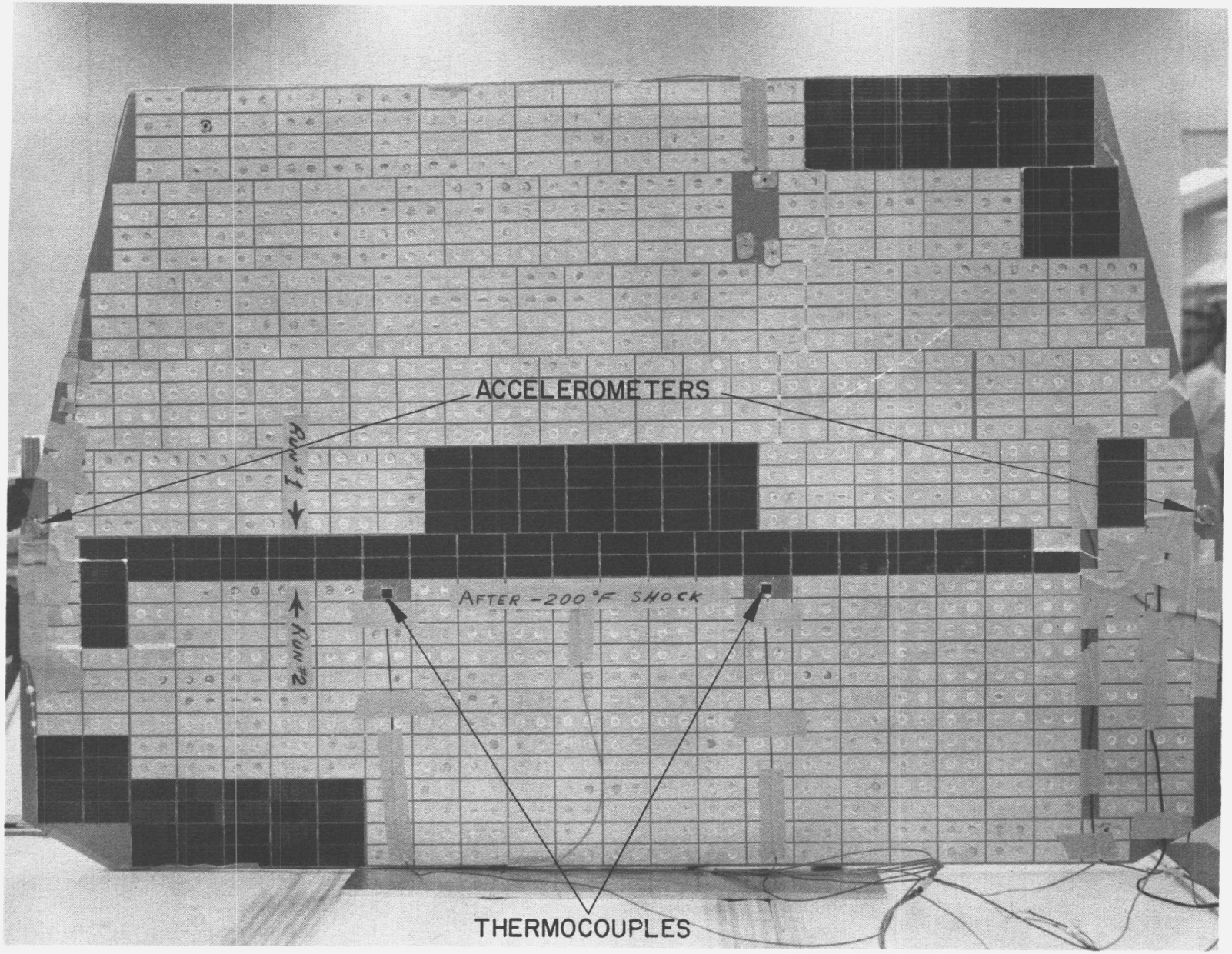


BEFORE



AFTER

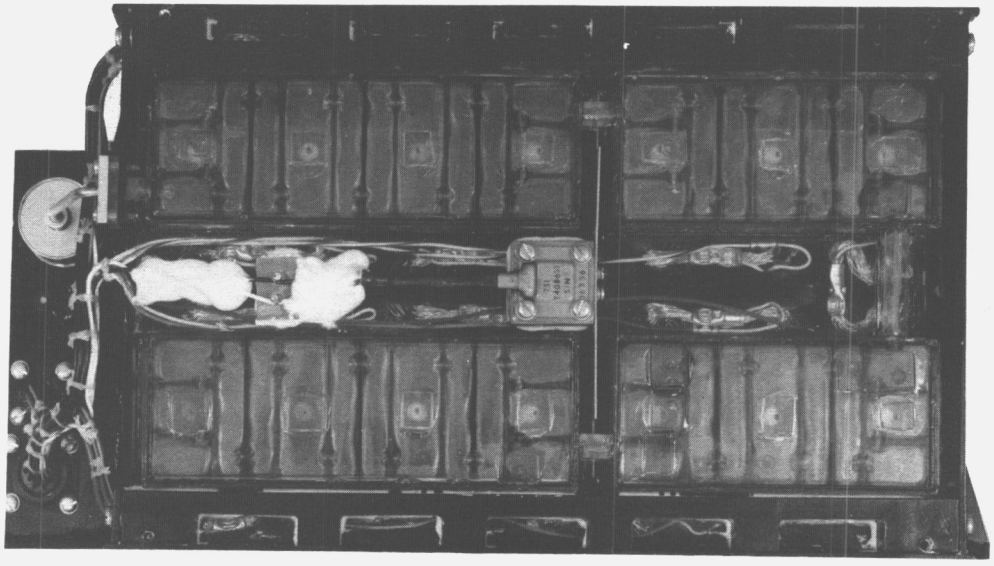
LUNAR COLD LANDING TEST OF SOLAR PANEL

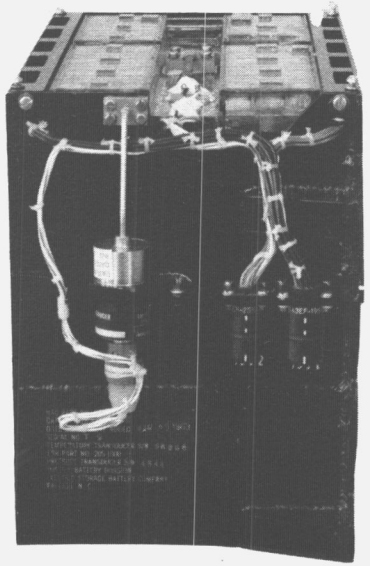


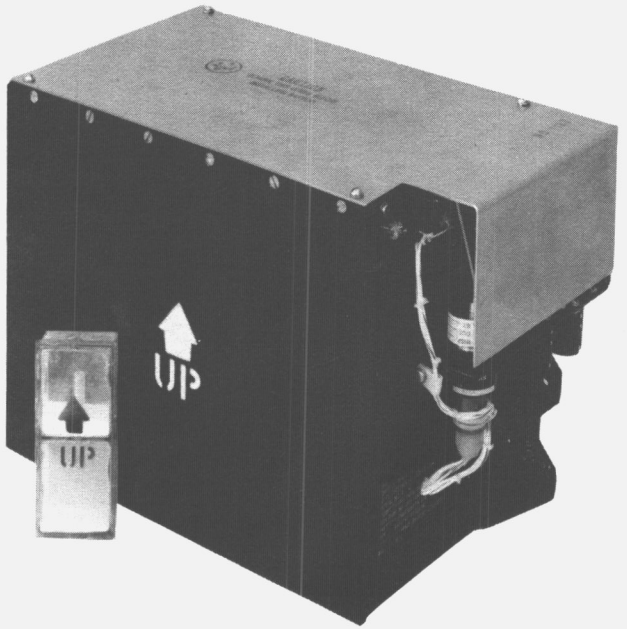
SOLAR PANEL COLD LANDING TESTS
ALL RESULTS SATISFACTORY

TYPE OF TEST	TEMPERATURE, °F	TEST LOAD, cps
VIBRATION, THRUST AXIS	-100	1.5 g, 5 to 340 1.8 g, 340 to 640 2.8 g, 640 to 1025 6.0 g, 1025 to 1500 0.3 g, 5 to 1050
VIBRATION, THRUST AXIS	-205	SAME AS ABOVE
SHOCK, THRUST AXIS	-210	25 g AT BASE OF MAST HALF-SINE WAVE FORM

PROTOTYPE BATTERY







BATTERY ELECTRICAL PERFORMANCE

SERIAL NUMBER	FIRST CHARGE INPUT, Amp-hr.	FIRST DISCHARGE OUTPUT, amp-hr.	SECOND CHARGE INPUT, amp-hr.	SECOND DISCHARGE OUTPUT, amp-hr.	THIRD CHARGE INPUT, amp-hr.	THIRD DISCHARGE OUTPUT, amp-hr.	BATTERY WEIGHT, lb
T-1	200	189.5	184	181.7	183.6	172.9	46.5
T-2	198.7	187.5	207.96	208.28	-	-	46.3

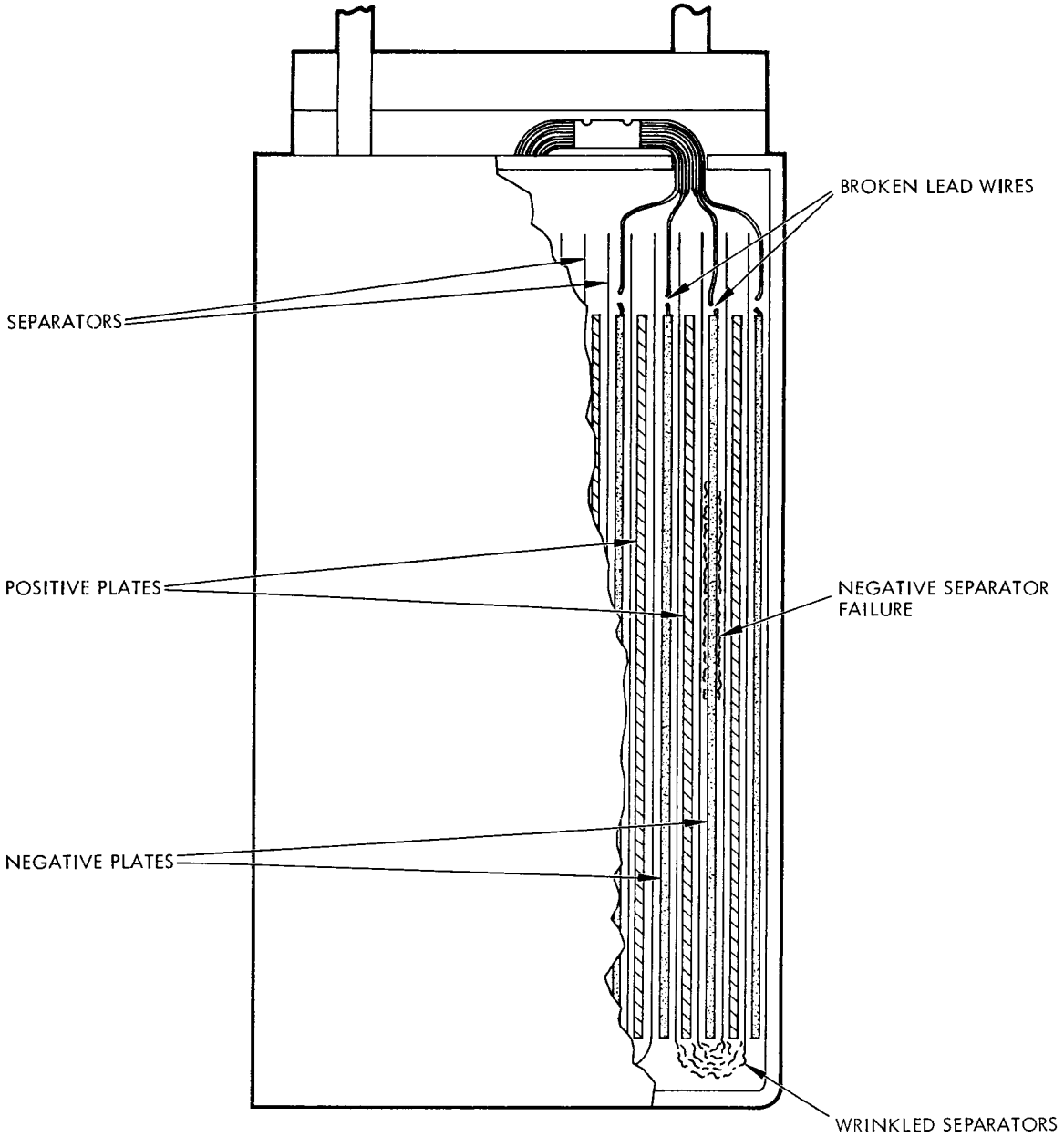
SPECIFICATION REQUIREMENTS

WEIGHT = 46 lb

CAPACITY = 150 amp-hr.

VOLTAGE = 17.5 to 27.3

BATTERY CELL VIBRATION FAILURES



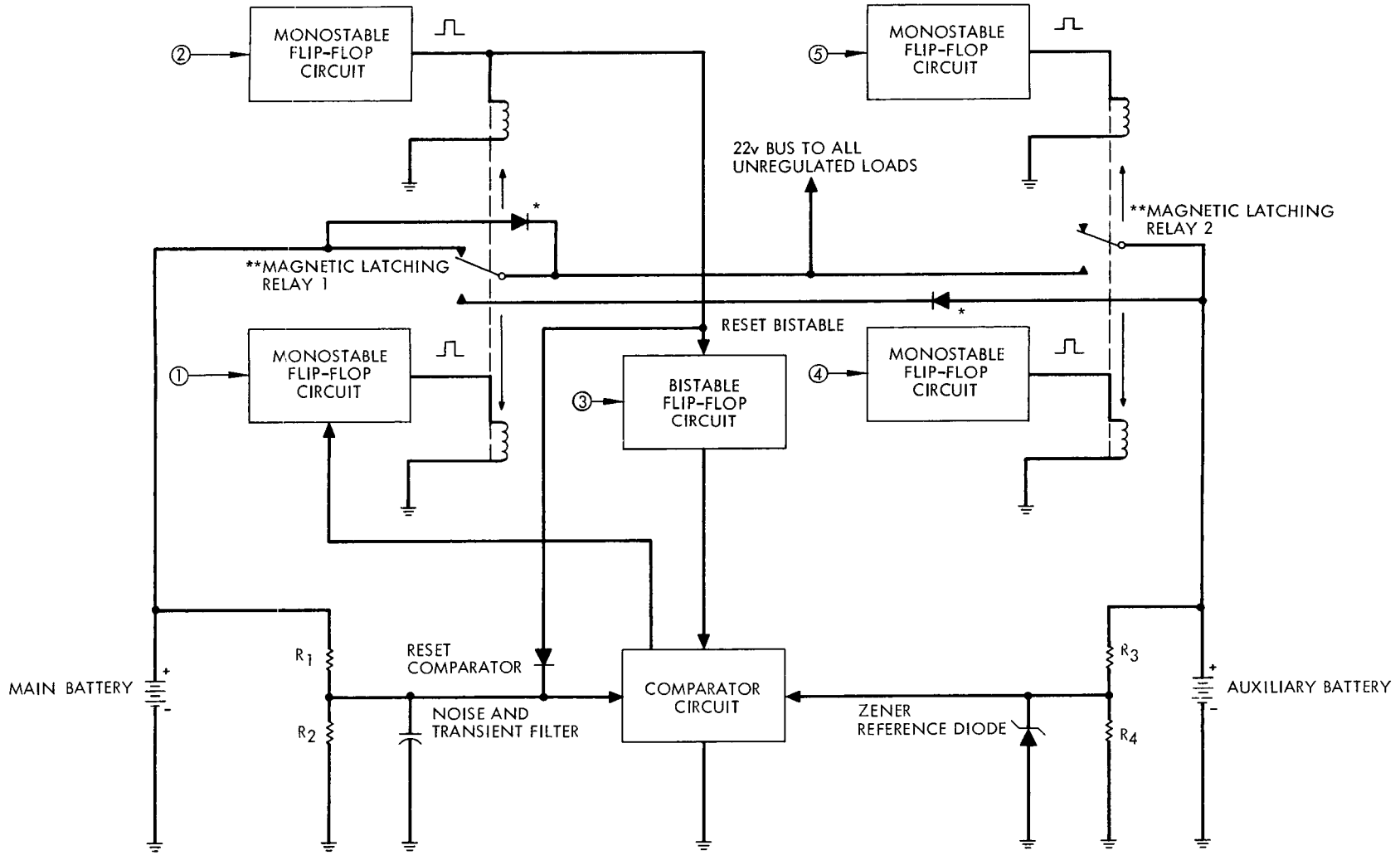
AUXILIARY BATTERY CHARACTERISTICS

MANUFACTURER: EAGLE-PICHER

- BATTERY TYPE:
  MANUALLY ACTIVATED SILVER-ZINC PRIMARY
- WEIGHT:
  21 lb
- CAPACITY:
  1000 w-hr.
- VOLTAGE:
  $22 \begin{smallmatrix} +4 \\ -3.5 \end{smallmatrix}$
- NO. OF CELLS:
  14
- VOLUME:
  355.3 $in.^3$
- DIMENSIONS:
  6.3 in. WIDE X 9.4 in. LONG X 6 in. HIGH*
- CASE:
  MAGNESIUM WITH THERMALLY COATED ALUMINUM TOP

*DOES NOT INCLUDE HEIGHT OF VALVE

AUXILIARY BATTERY POWER SYSTEM

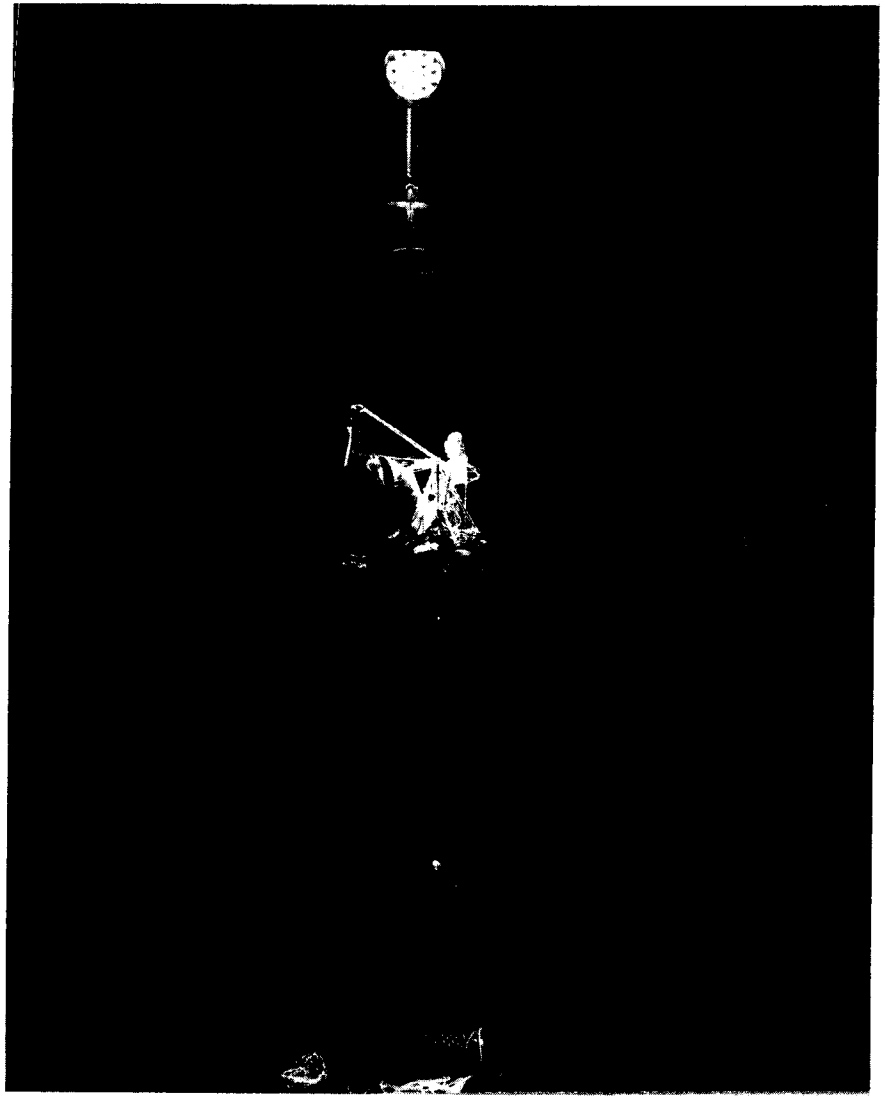


* TWO PARALLEL DIODES, EITHER OF WHICH CAN HANDLE PEAK CURRENTS, ARE USED FOR REDUNDANCY
** FOUR RELAY CONTACTS ARE CONNECTED IN PARALLEL FOR REDUNDANCY AND CURRENT CARRYING CAPACITY

COMMANDS

① AUXILIARY BATTERY MODE ON
② RESTORE MAIN BATTERY MODE
③ DISABLE BATTERY TRANSFER LOGIC
④ HIGH CURRENT MODE ON
⑤ HIGH CURRENT MODE OFF

TRANSIT TEST OF THERMAL MODEL MT-1, SECTOR II



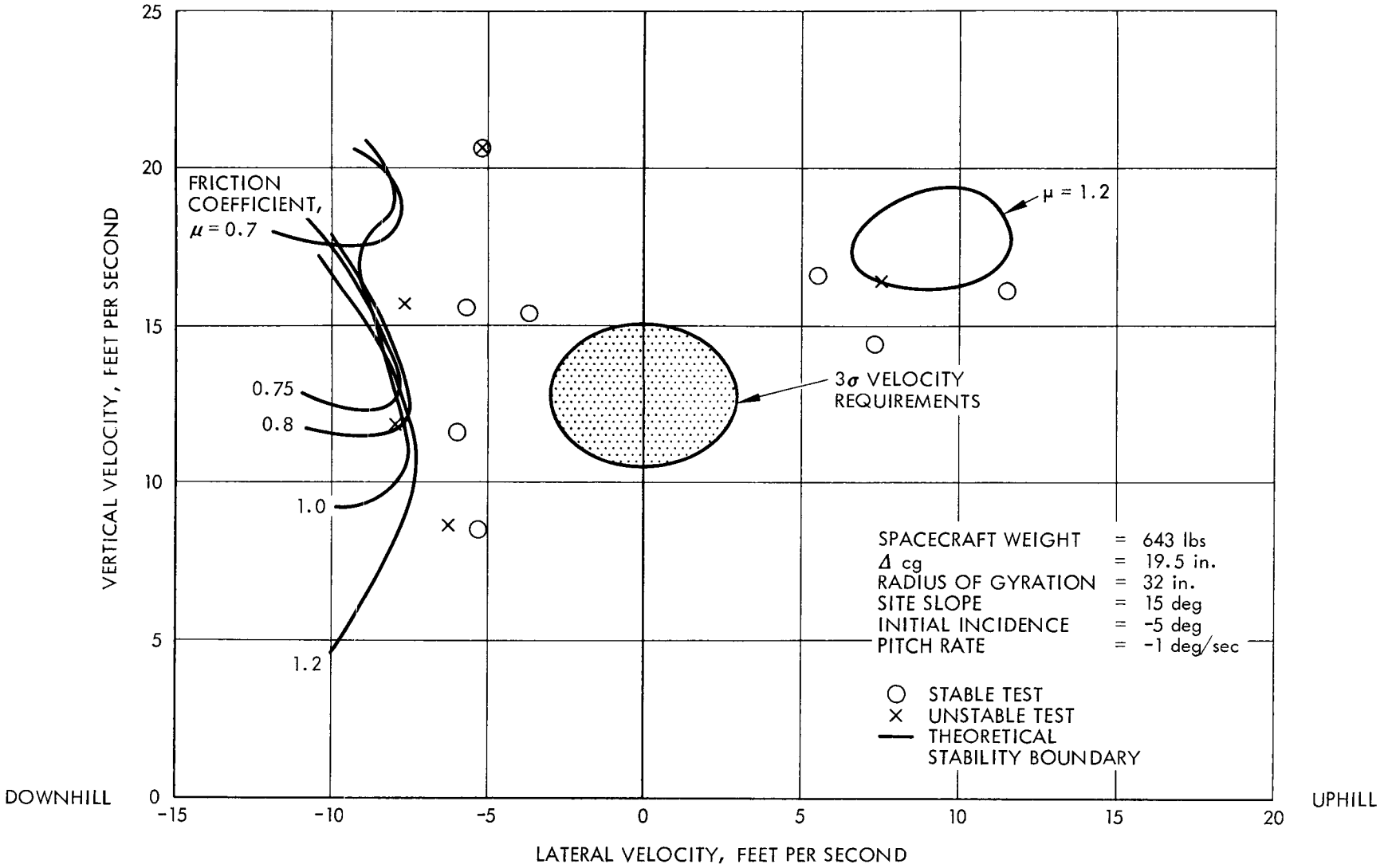
TEST AND PREDICTED TRANSIT TEMPERATURES

MT-I SECTOR II

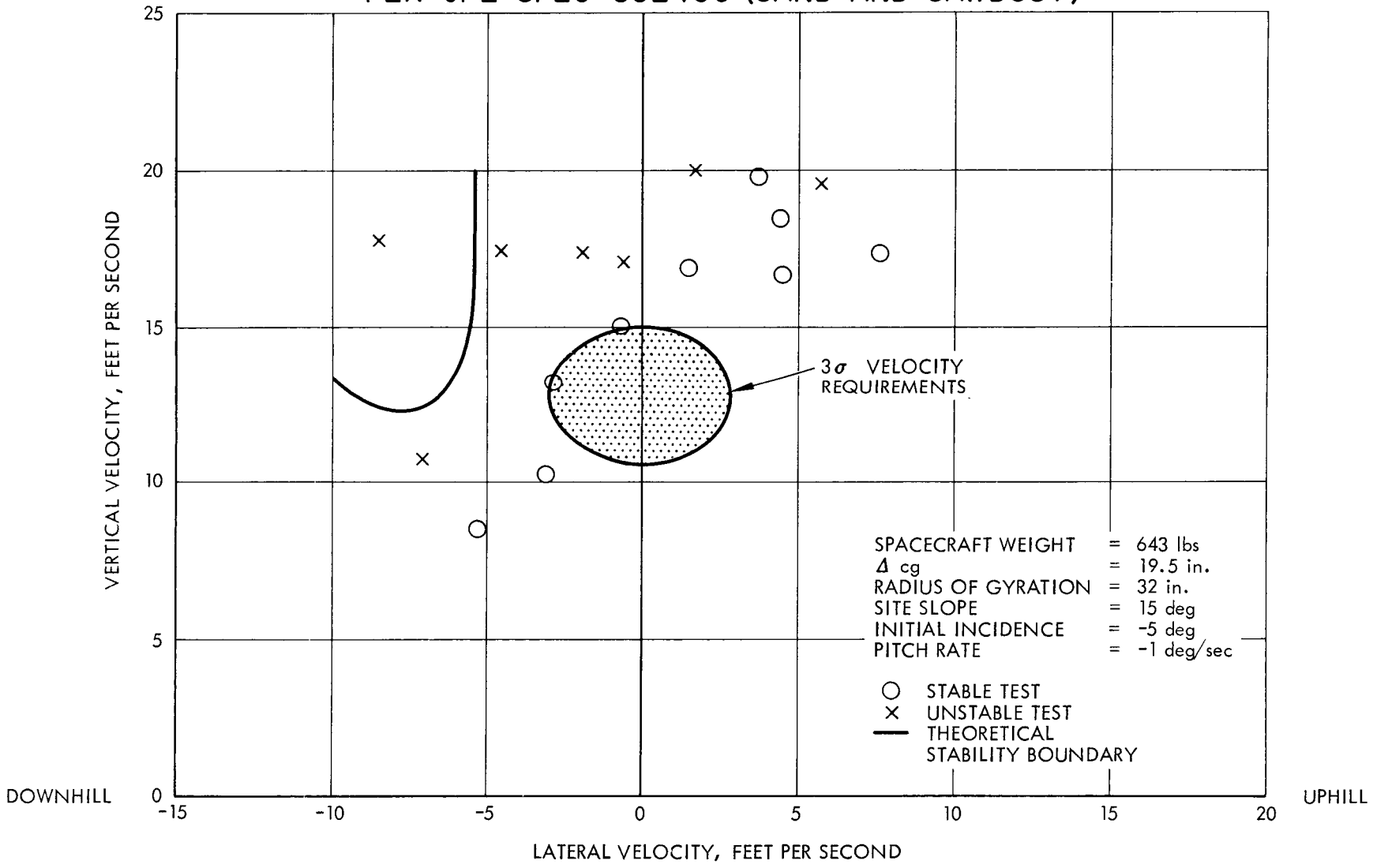
MT-1 SECTOR II SUBSYSTEM	TEMPERATURE REQUIREMENT, °F	TEST NO. 1 TEMPERATURES, °F		TEST NO. 2 TEMPERATURES, °F		
		PREDICTED	TEST	PREDICTED		TEST
		100% INTENSITY	100% ± 15% INTENSITY	100% INTENSITY	85% INTENSITY	85% ± 3% INTENSITY
1 COMPARTMENT B						
SWITCH RADIATORS	——	54	75 TO 93	66 TO 82*	50 TO 66*	54 TO 64*
THERMAL TRAY	0 TO 125	85 TO 87*	98 TO 108*	——	——	——
2 VERNIER SYSTEM						
VERNIER ENGINE	0 TO 100	55 TO 63	149 TO 161	54 TO 101	40 TO 85	25 TO 75
FUEL TANK (PAINTED)	0 TO 100	80 TO 130	123 TO 159	63 TO 98	47 TO 82	42 TO 68
OXIDIZER TANK (PAINTED)	0 TO 100	80	72	23 TO 103	17 TO 88	40 TO 50
3 FCSG						
CANOPUS RADIATOR	——	47	126	66	——	100
CANOPUS BASE, INTERNAL	-20 TO 125	65	115	69	——	99
CANOPUS SUN SHADE	——	-22	31	-10	——	25
SUN SENSOR	35 TO 120	69	9	66	——	81
MOUNTING PLATE	0 TO 140	69	100	66	——	77
IRU RADIATOR	——	150	150	155 TO 165	——	162
IRU GYRO MOUNTING RING	180 ± 2	170 TO 180	——	170 TO 180	——	173
4 RADVS						
VELOCITY SENSOR ANTENNA DISH	-250 TO 250	23 TO 68	52 TO 68	-29 TO 145	-46 TO 130	-28 TO 76
VELOCITY SENSOR ANTENNA SEPTUM	-250 TO 250	-190 TO 130	38	-190 TO 130	-190 TO 120	13
SIGNAL DATA CONVERTER	40 TO 78	15 TO 65	140 TO 179	28 TO 53	7 TO 30	12 TO 30
5 TV CAMERA NO. 2	7 - 200	-76	-16 TO 9	——	——	-60
6 SPACE FRAME						
UPPER	-120 TO 100	-62 TO -22	-55 TO 70	-50 TO 0	——	-60 TO 7
LOWER	-140 TO 100	-12 TO 123	-35 TO 73	-20 TO 40	——	0 TO 35

*AT 15 WATTS

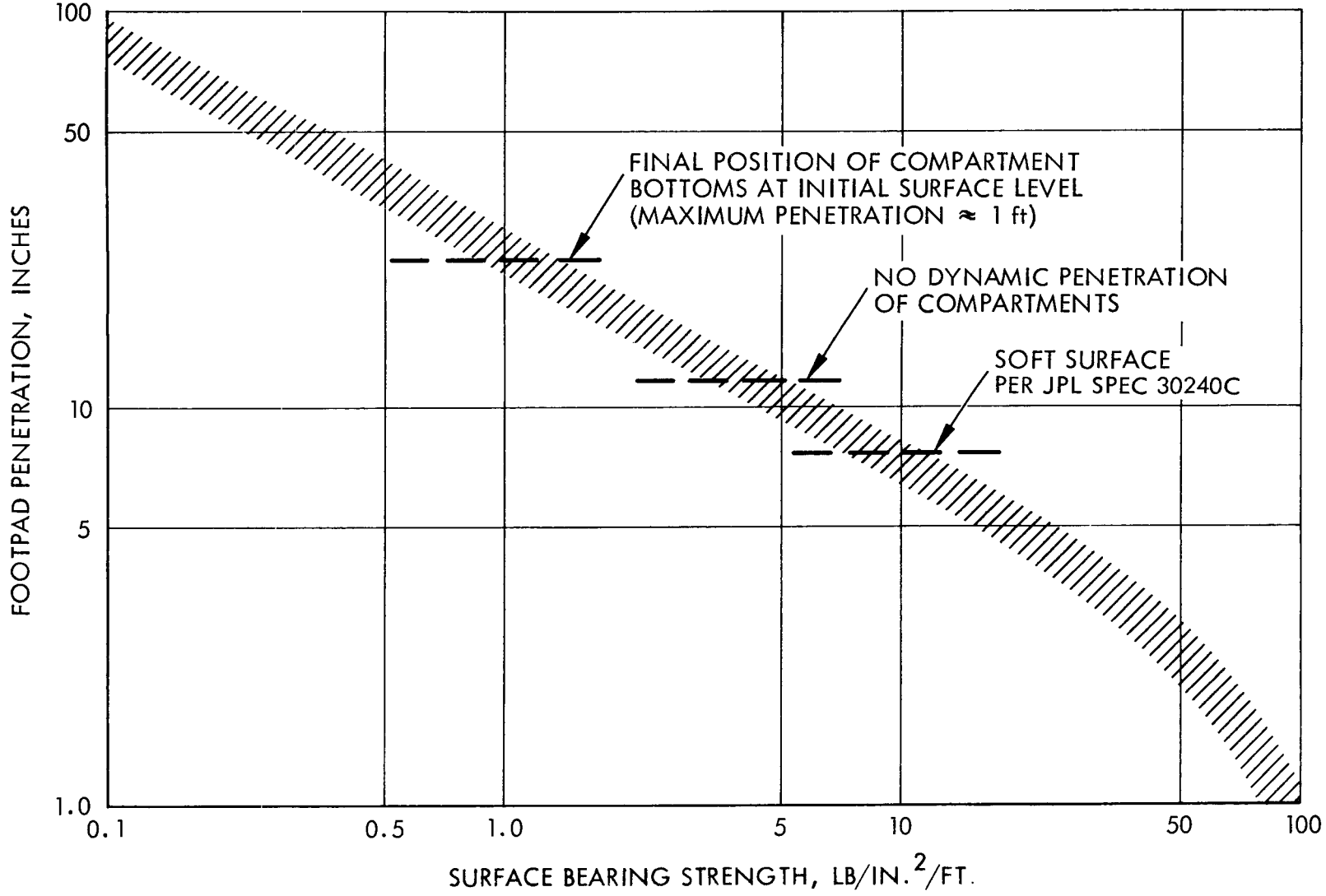
T-1 (A-21) DROP TEST ON HARD ROCKY SURFACE



T-1 (A-21) DROP TEST ON SOFT SURFACE
PER JPL SPEC 30240C (SAND AND SAWDUST)

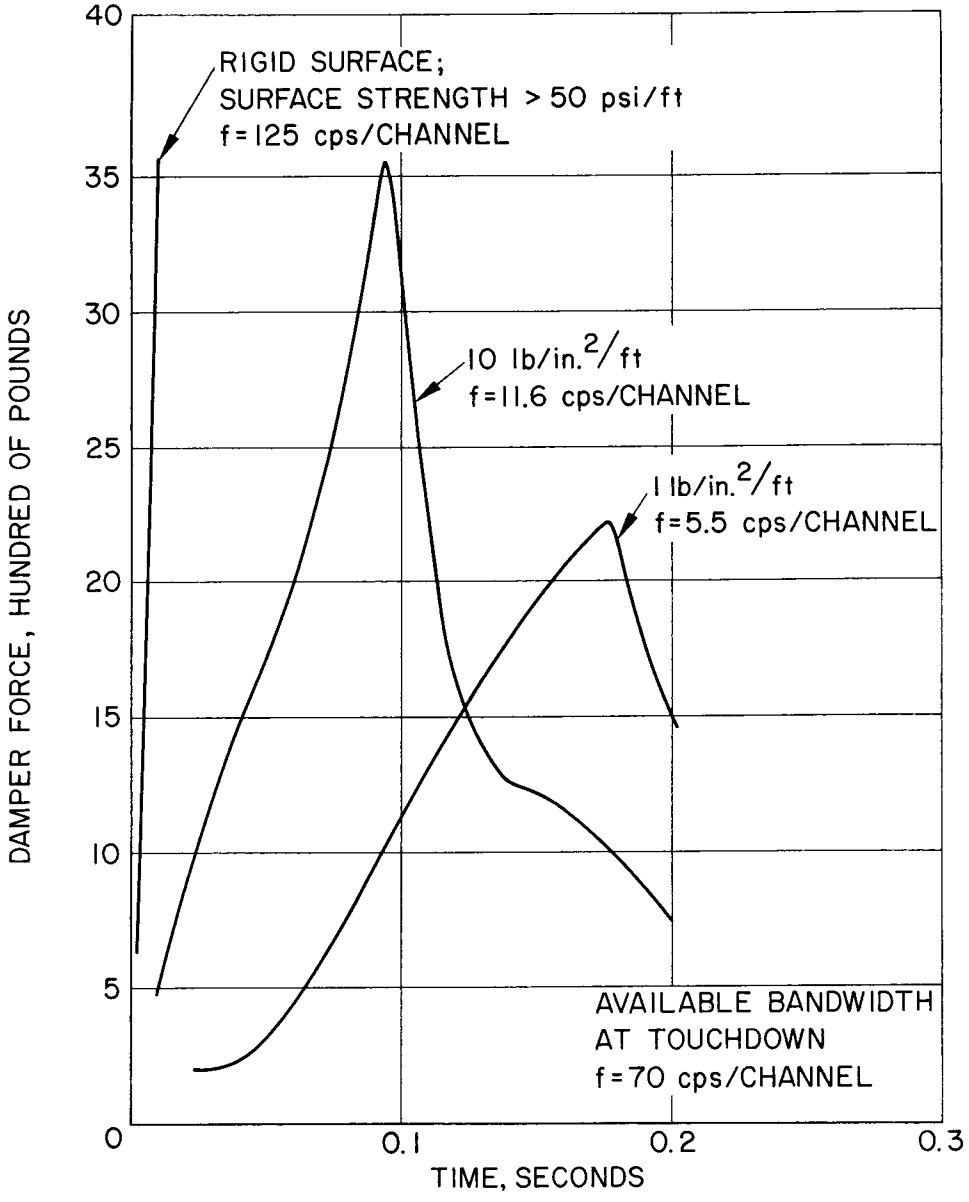


FOOTPAD PENETRATION
TOUCHDOWN VERTICAL VELOCITY = 20 FPS

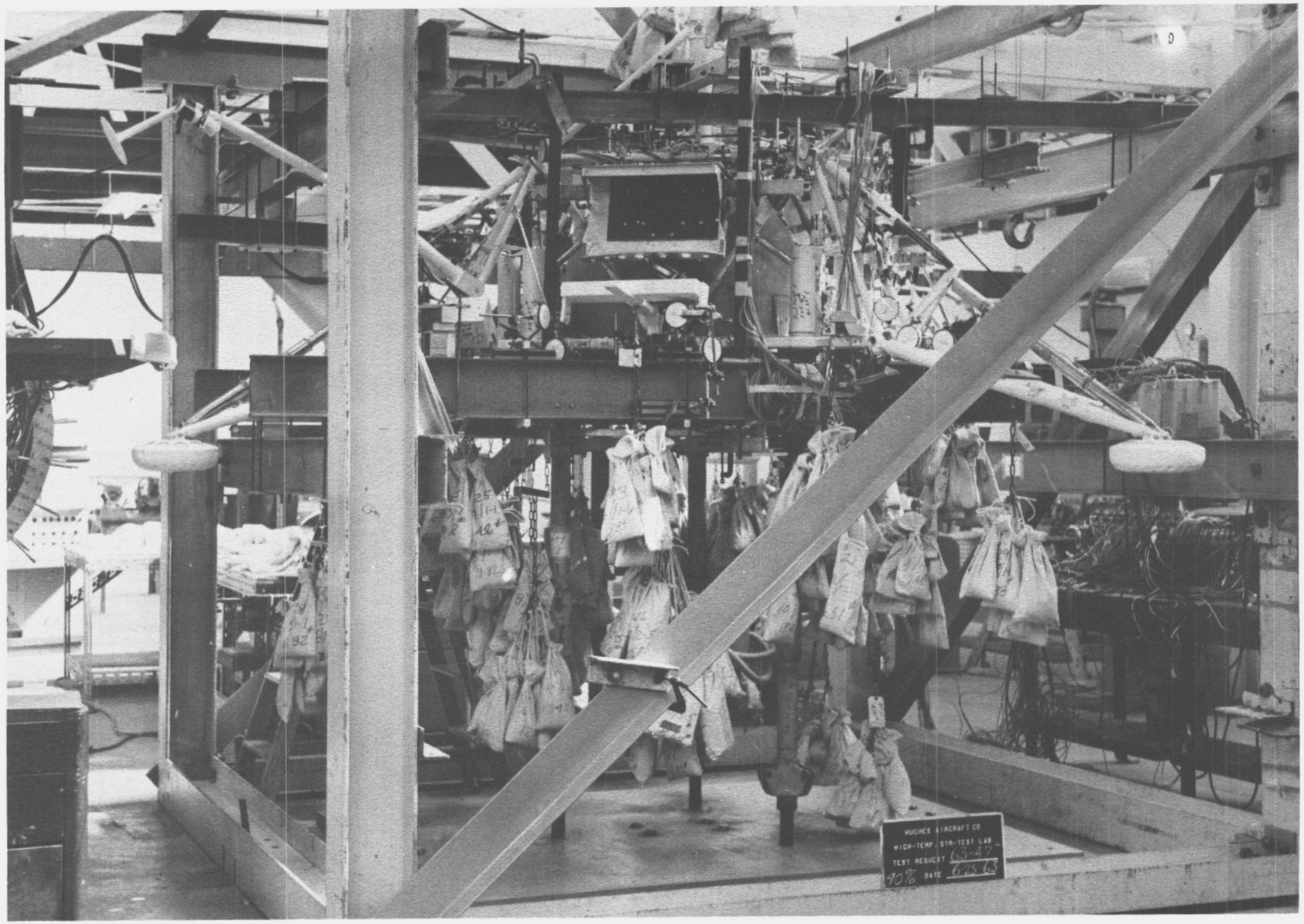


SHOCK ABSORBER FORCE AND REQUIRED COMMUNICATIONS BANDWIDTH

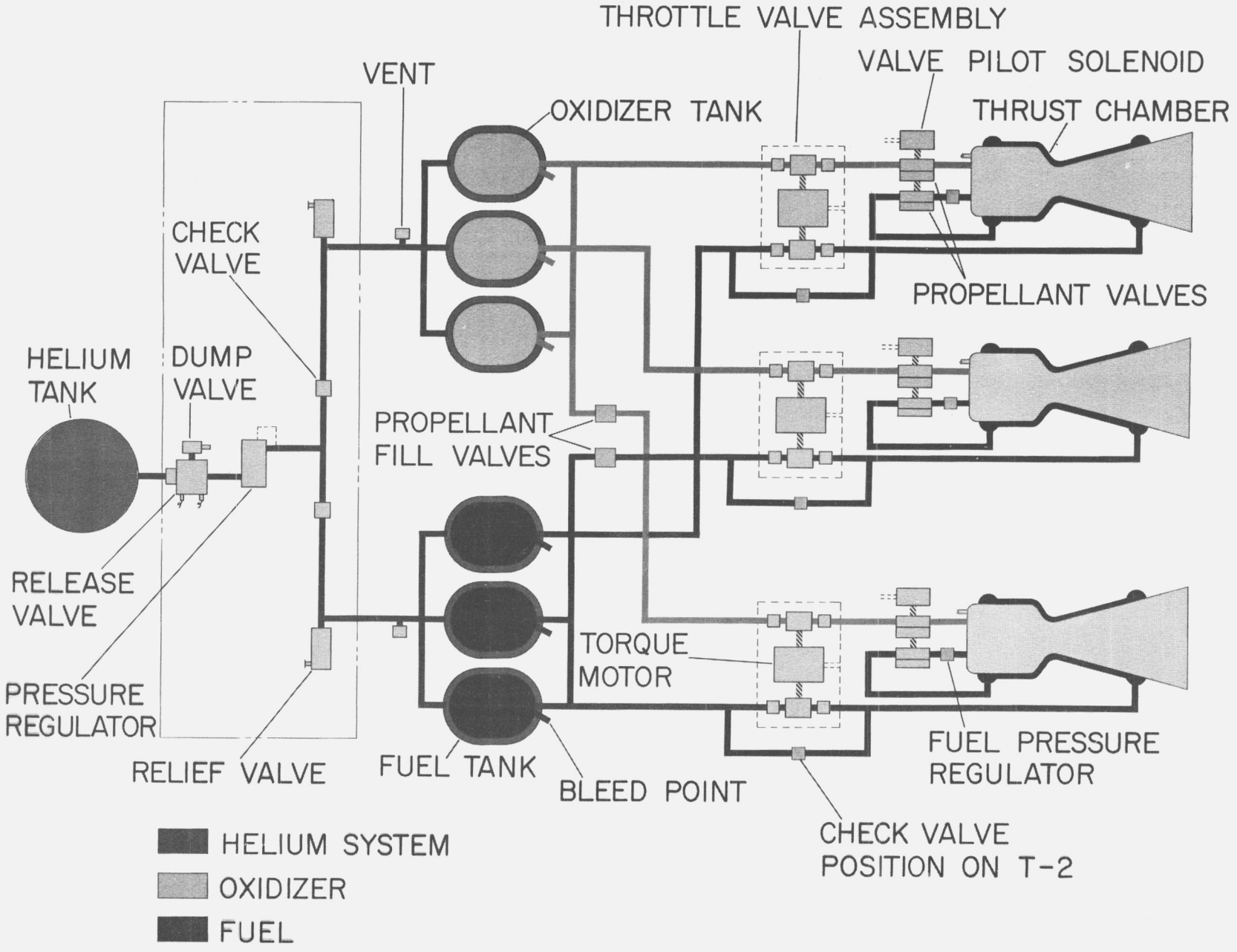
20 FPS NORMAL IMPACT



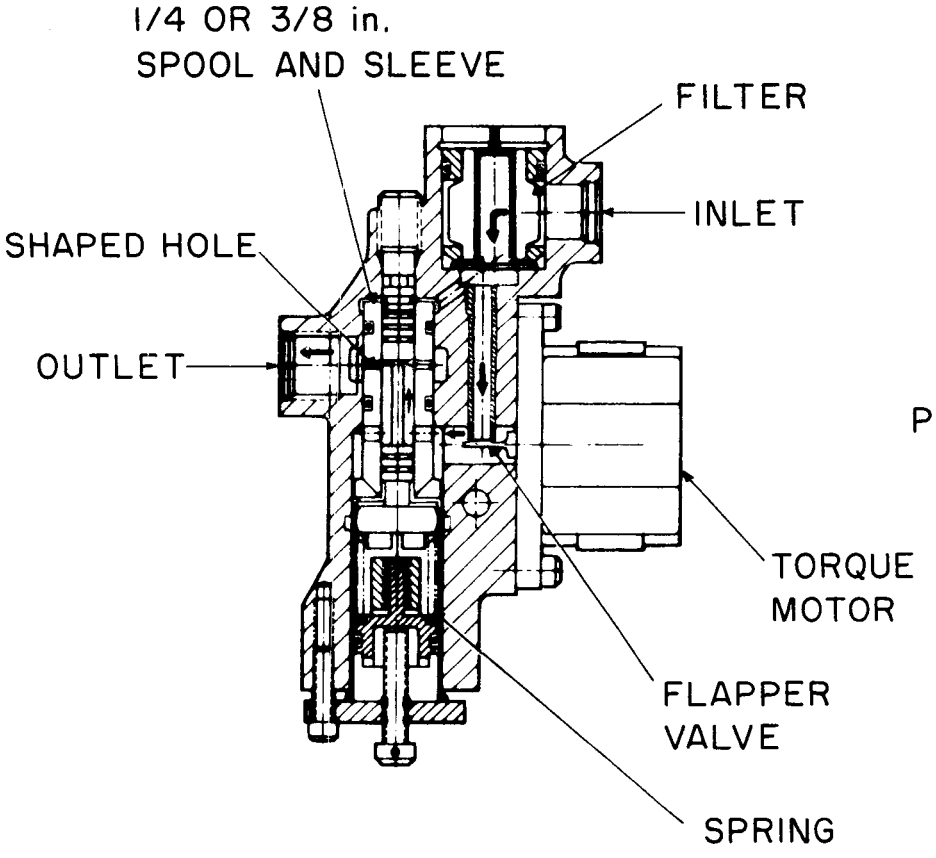
S-2 STATIC DEFLECTION TEST



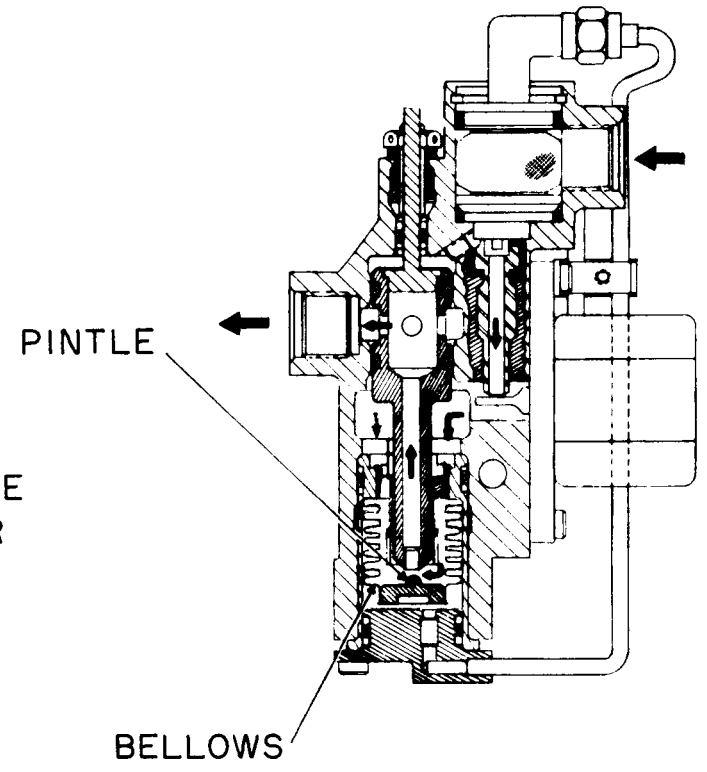
VERNIER PROPULSION SYSTEM SCHEMATIC



PROPELLANT THROTTLE VALVES

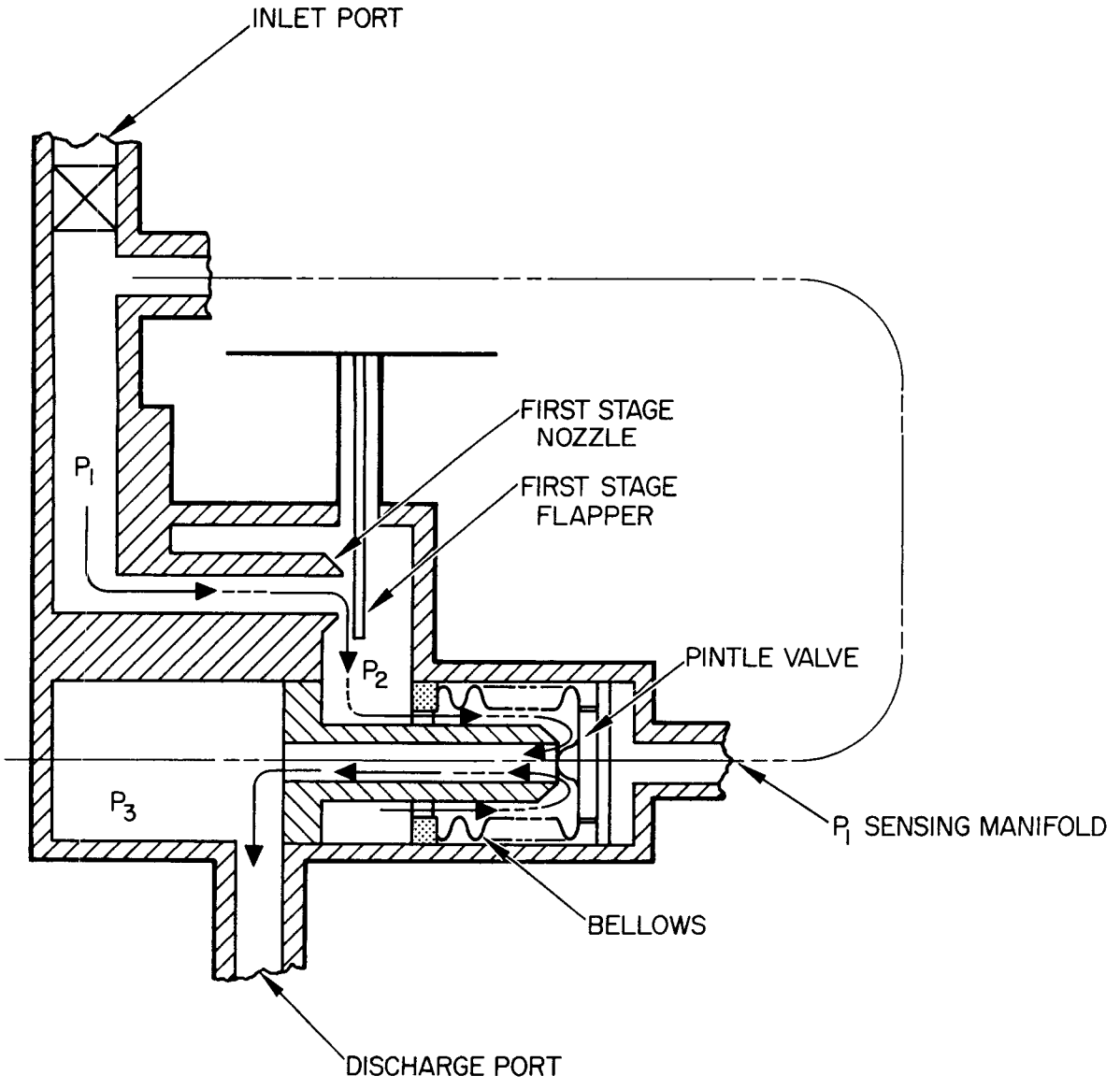


SPOOL AND SLEEVE



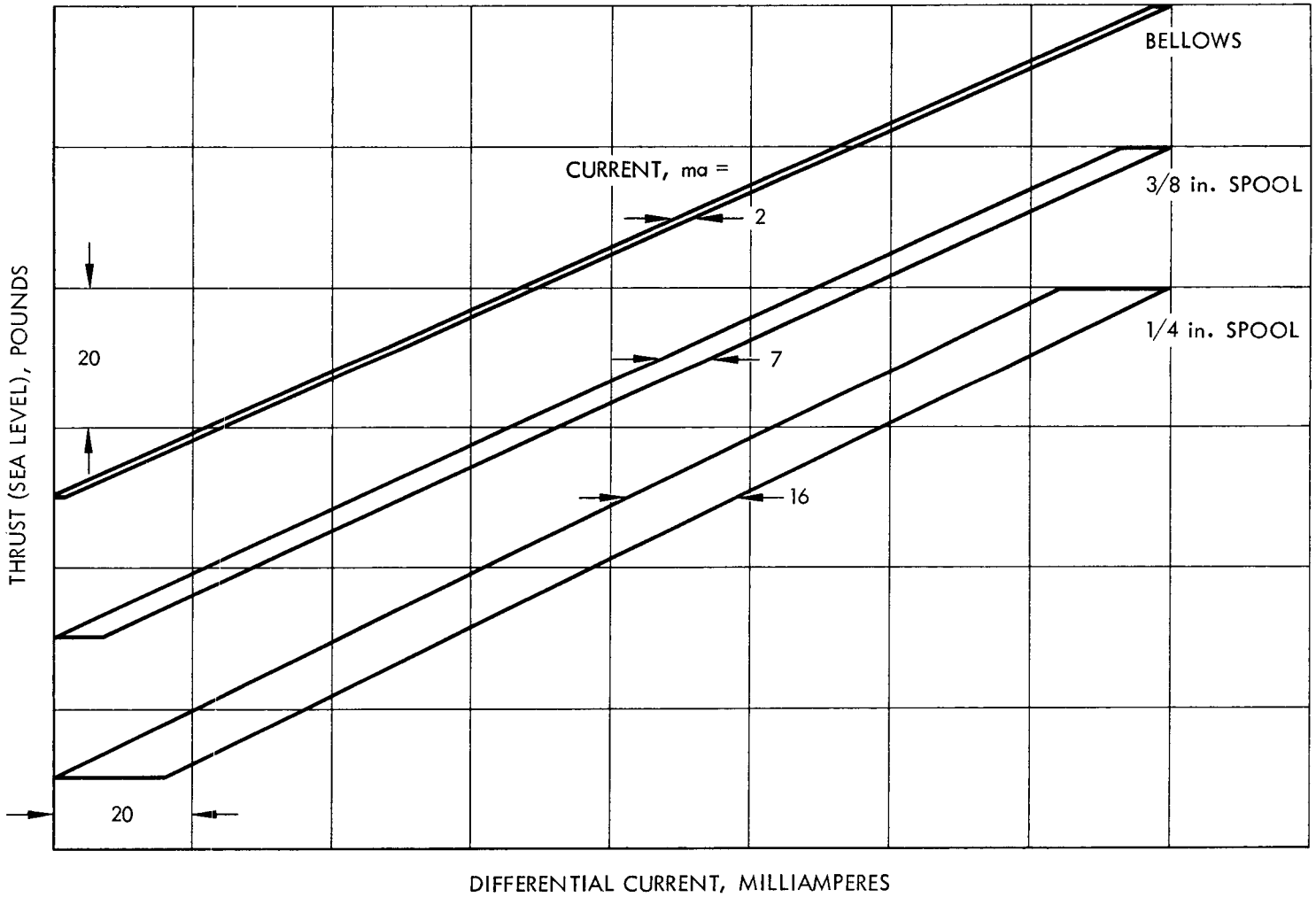
BELLOWS OPERATED PINTLE

THROTTLE VALVE WITH BELLOWS OPERATED PINTLE

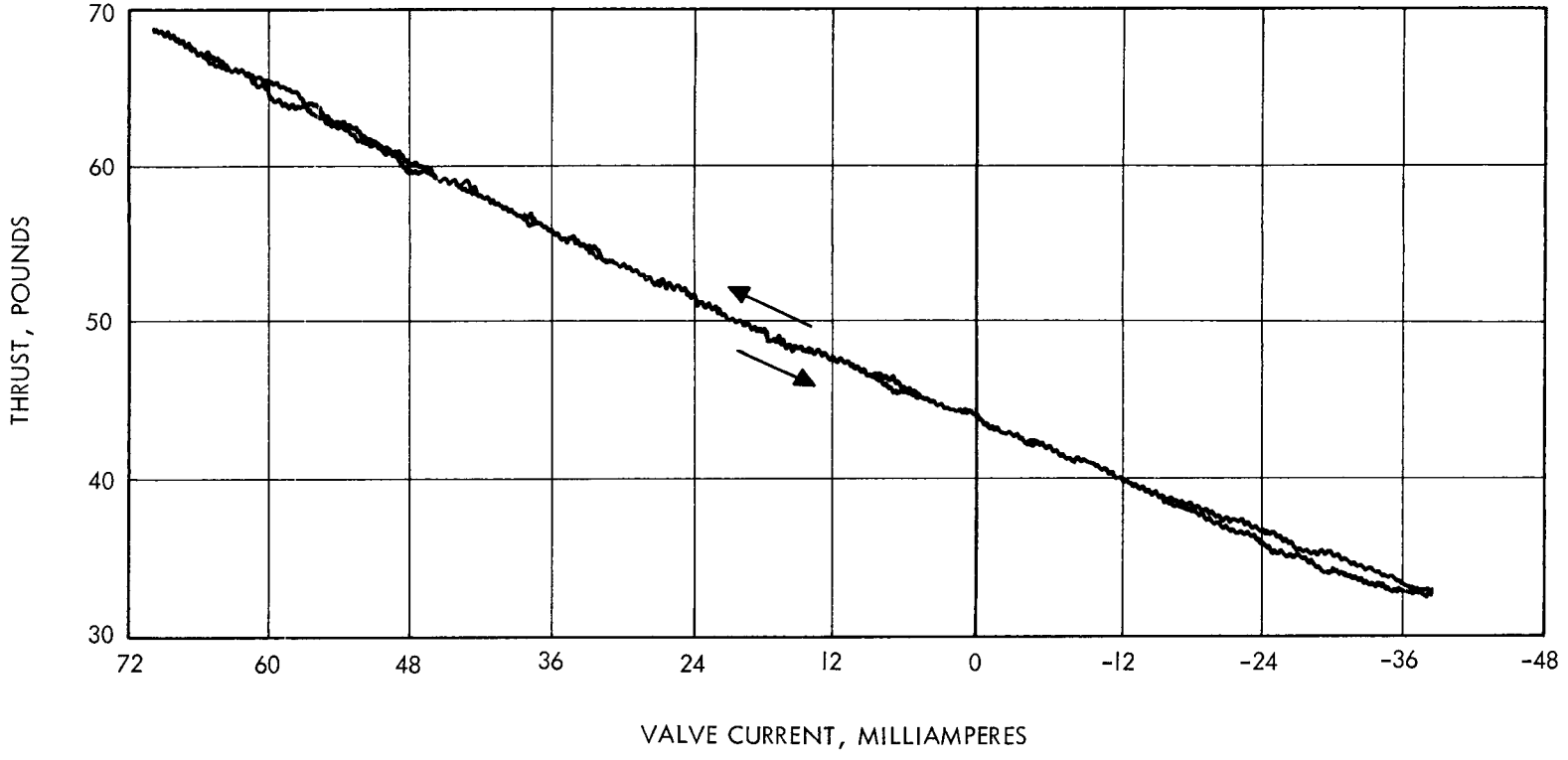


VERNIER VALVE COMPARATIVE HYSTERESIS

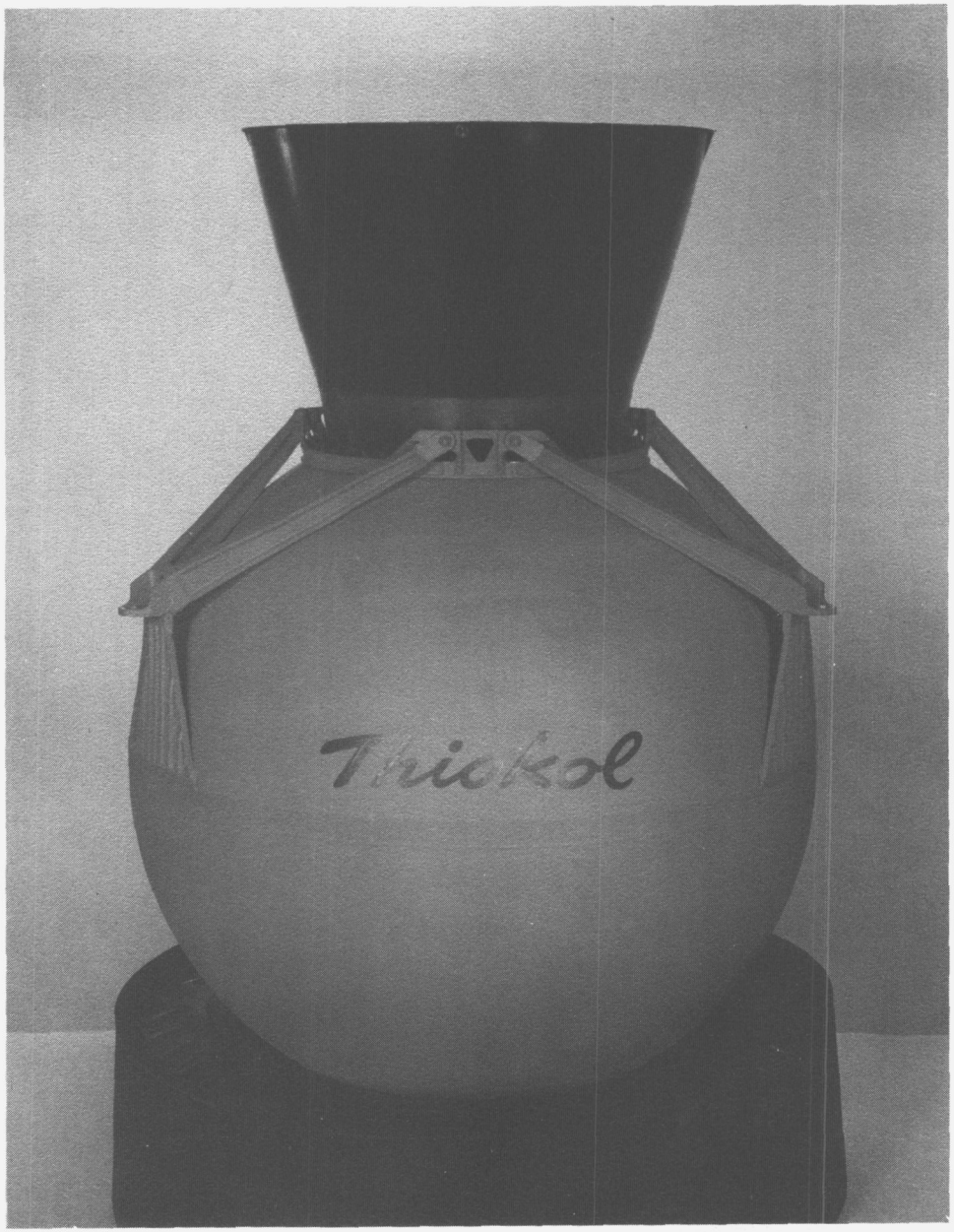
(BASED ON COLD FLOW TESTS)



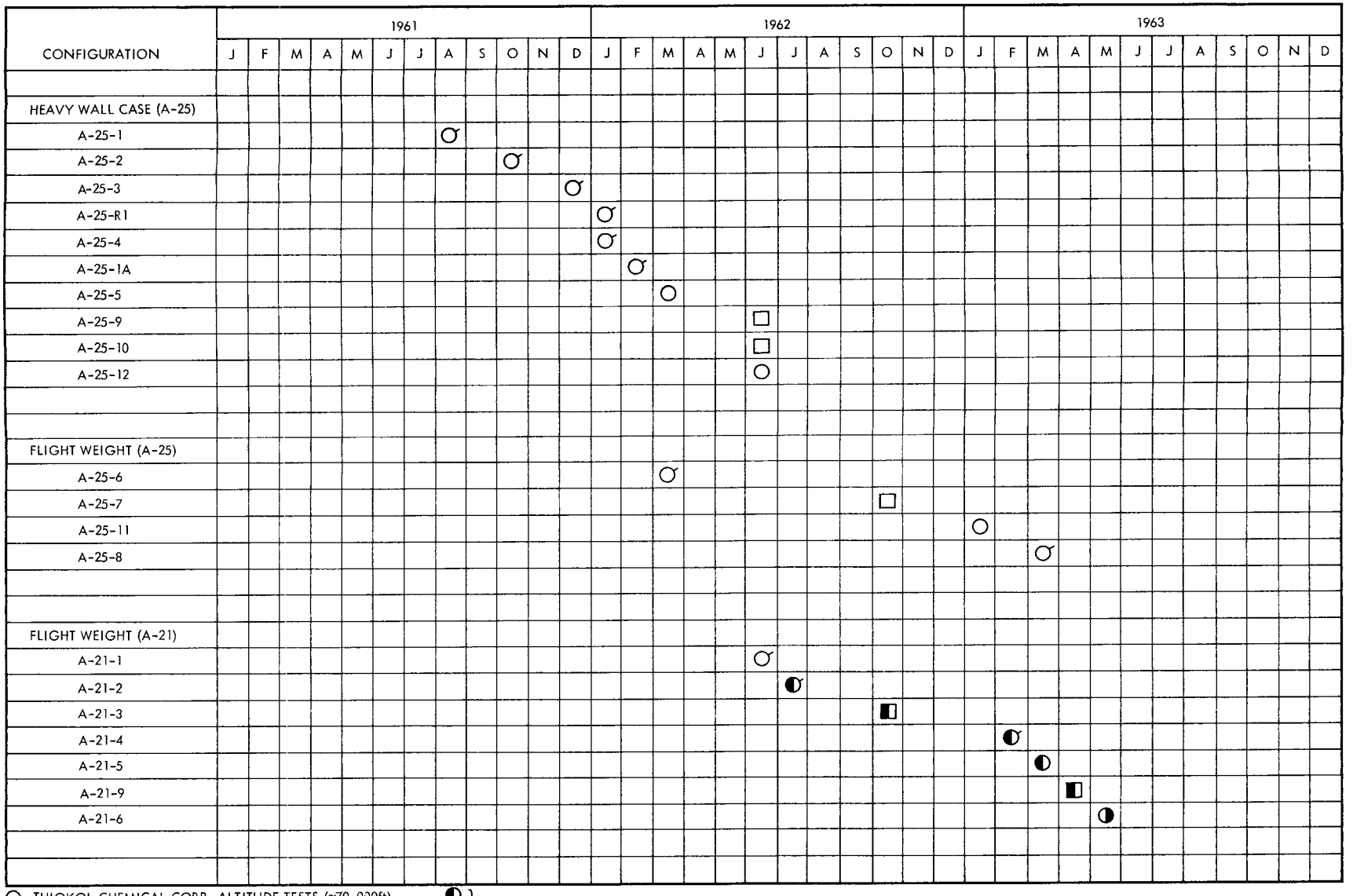
T-2 BELLOWS THROTTLE VALVE PERFORMANCE
TEST 7AX-1286, 5-25-63



FLIGHT TYPE RETRO ENGINE



RETRO ENGINE FIRINGS TO DATE



○ THIOKOL CHEMICAL CORP. ALTITUDE TESTS (≈70,000ft)

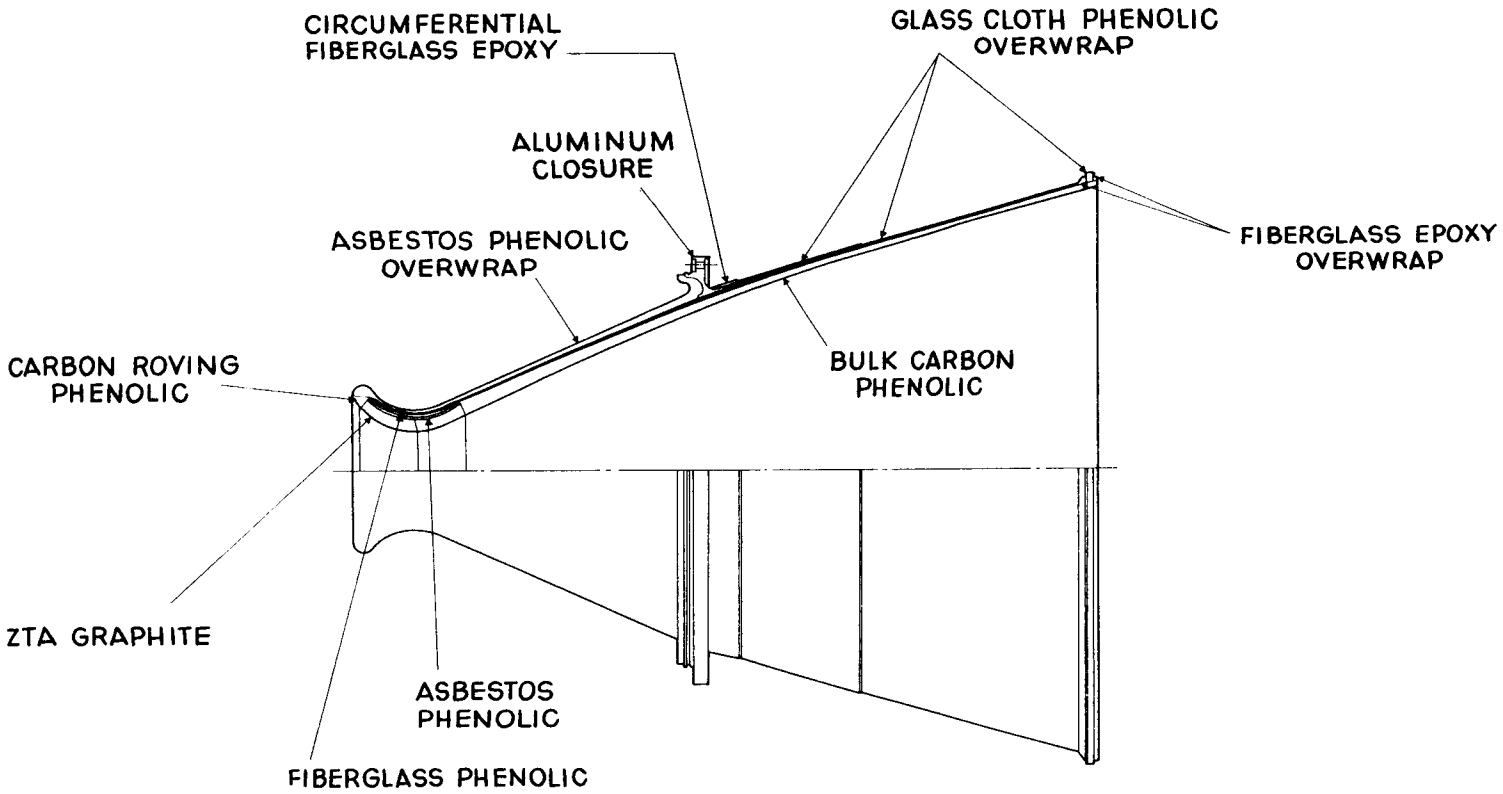
ϭ THIOKOL CHEMICAL CORP. SEA LEVEL TESTS

□ AEDC ALTITUDE TESTS (>100,000 ft)

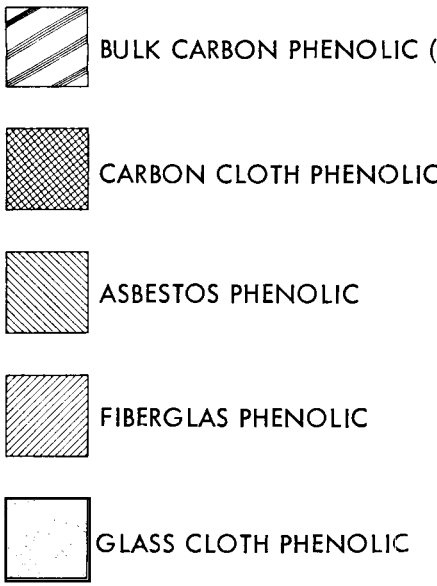
◐ ◧ } CG DETERMINATION

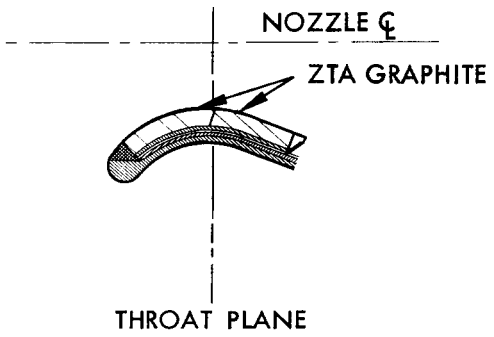
◑ ◨ } ENGINE SUBJECT TO DROP TEST PRIOR TO FIRING

FLIGHT NOZZLE

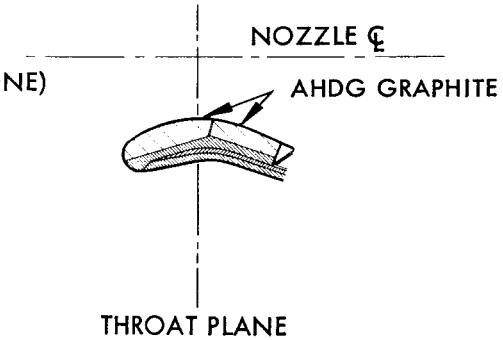


RETRO NOZZLE CONFIGURATIONS

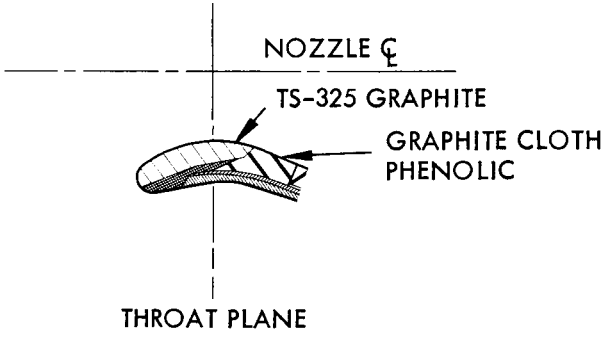




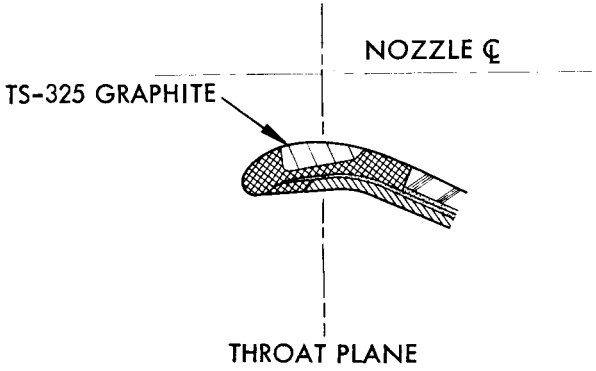
NO. 1



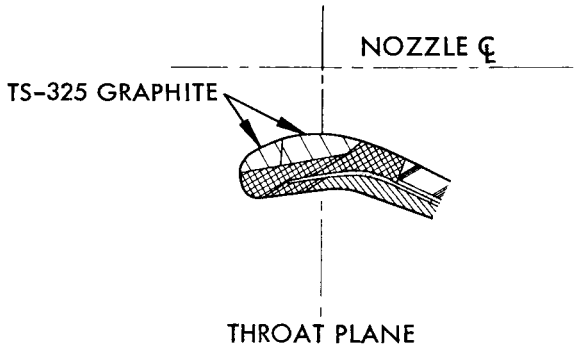
NO. 2



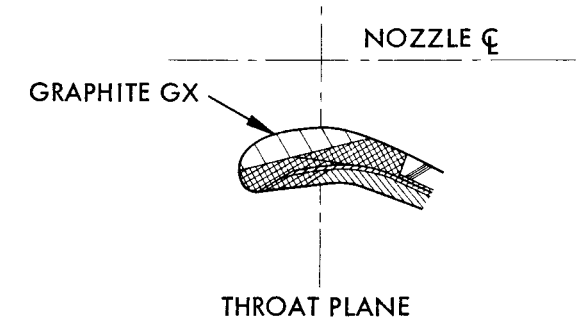
NO. 3



NO. 4



NO. 5

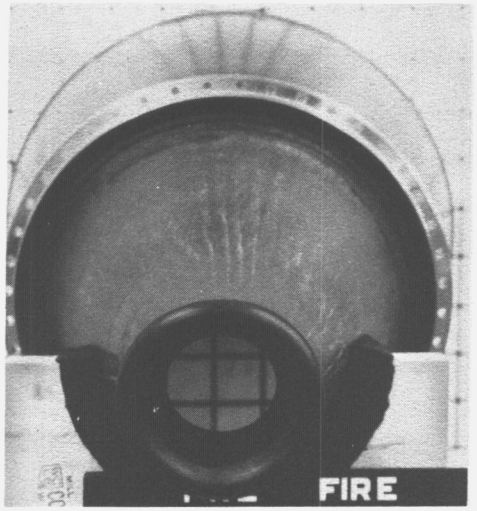


NO. 6

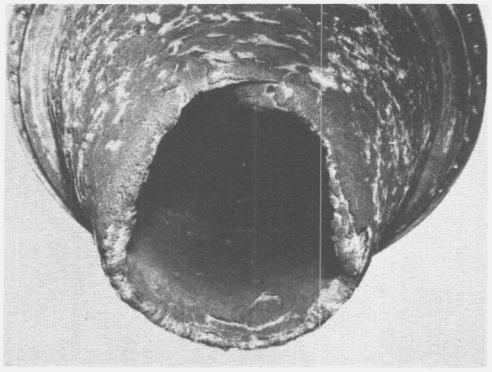
FLIGHT WEIGHT NOZZLE TEST SUMMARY

ENGINE NO.	TEST DATE	TEST ALTITUDE, ft	NOZZLE INSERT CONFIGURATION	ACTION TIME, sec	SPECIFIC IMPULSE I_{sp} (VAC), sec	RESULTS
A-21-4	2-22-63	SEA LEVEL	NO. 1, ZTA GRAPHITE	NOT AVAILABLE	NOT AVAILABLE	INSERT FAILED AT 1.3 sec FROM THERMAL SHOCK
A-25-8	3-22-63	SEA LEVEL	NO. 2, AHDG GRAPHITE	45.95	NOT AVAILABLE	SATISFACTORY
A-21-5	3-27-63	72,000	NO. 2, AHDG GRAPHITE	40.96	289.6	SATISFACTORY
A-21-9	4-12-63	130,000	NO. 2, AHDG GRAPHITE	NOT AVAILABLE	NOT AVAILABLE	INSERT FAILED AT 8.8 sec BECAUSE OF GRAPHITE QUALITY, OR GAS EVOLUTION BEHIND INSERT
A-21-6	5-8-63	75,000	NO. 3, TS-325 GRAPHITE	41.96	291.6	PERFORMANCE SATISFACTORY; INSERT CRACKED DURING FIRING.
A-25-13N	7-17-63	SEA LEVEL	NO. 4, TS-325 GRAPHITE	—	—	—
A-25-14N	7-24-63	SEA LEVEL	NO. 5, TS-325 GRAPHITE	—	—	—
A-25-15N	7-31-63	SEA LEVEL	NO. 6, GRAPHITE GX	—	—	—
A-25-16N	9-4-63	VACUUM	WILL BE DETERMINED AFTER TESTS OF CONFIGURATION NOS. 4, 5, AND 6	—	—	—
A-25-17N	9-11-63	VACUUM		—	—	—
A-25-18N	9-18-63	VACUUM		—	—	—

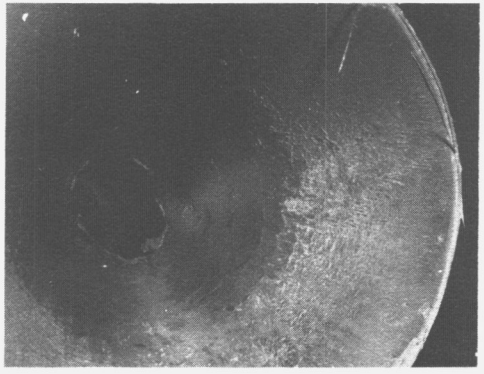
A-21-9 ENGINE NOZZLE TEST



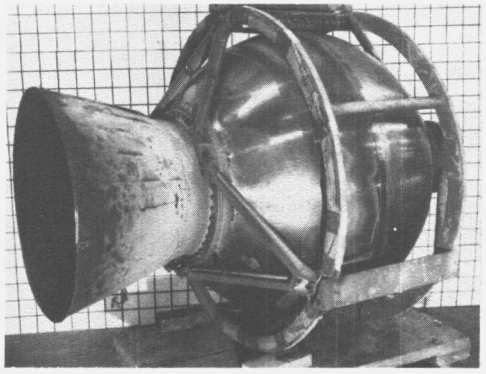
BEFORE FIRING



AFTER FIRING

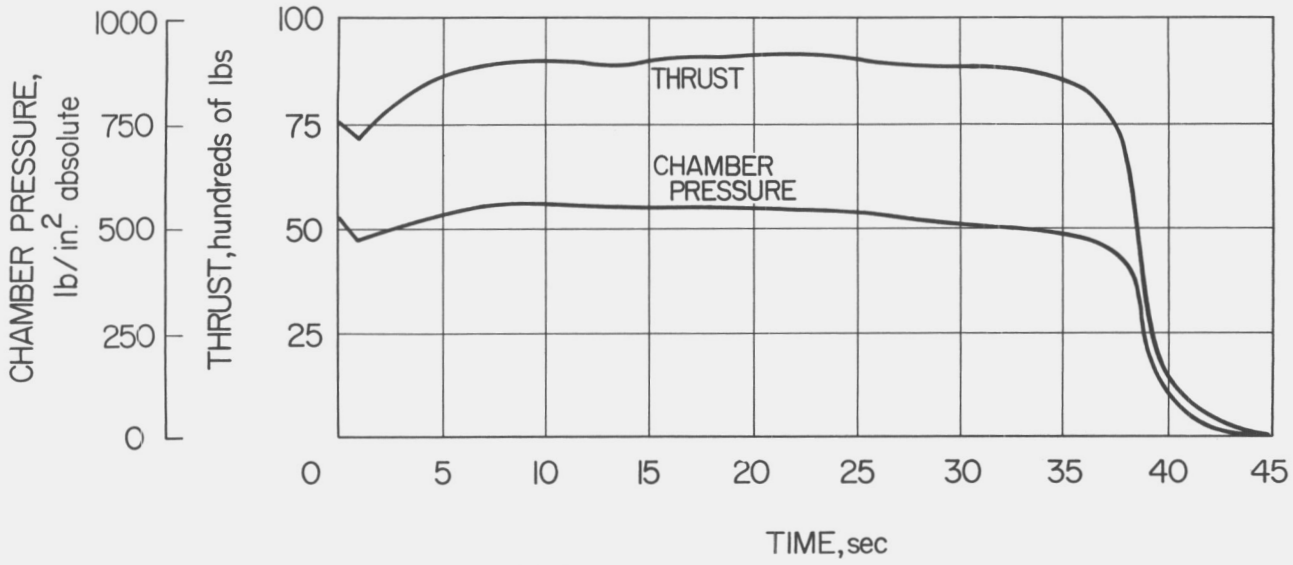


EXIT CONE AFTER FIRING



ENGINE AFTER FIRING

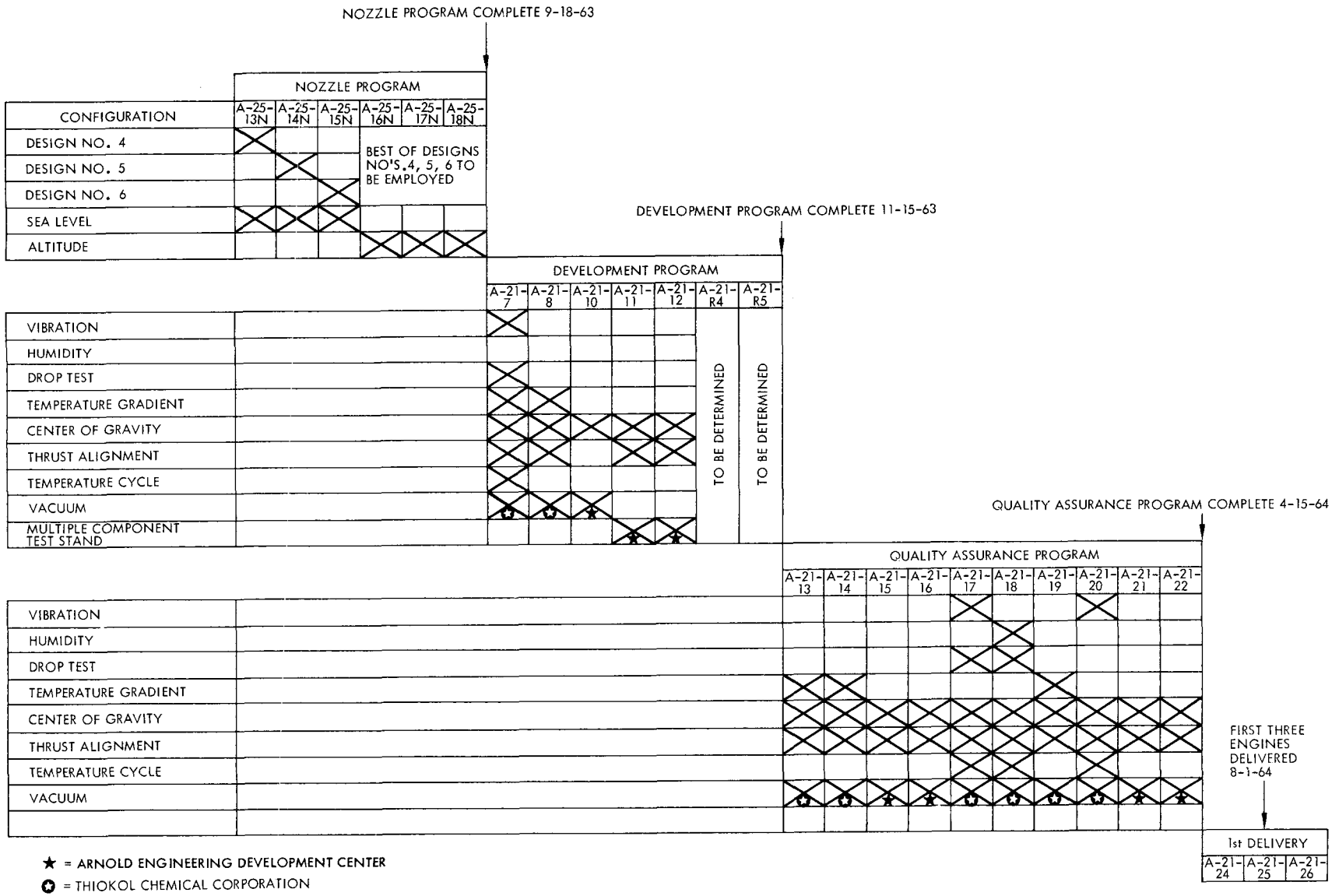
A-21-6 ENGINE TEST FIRING



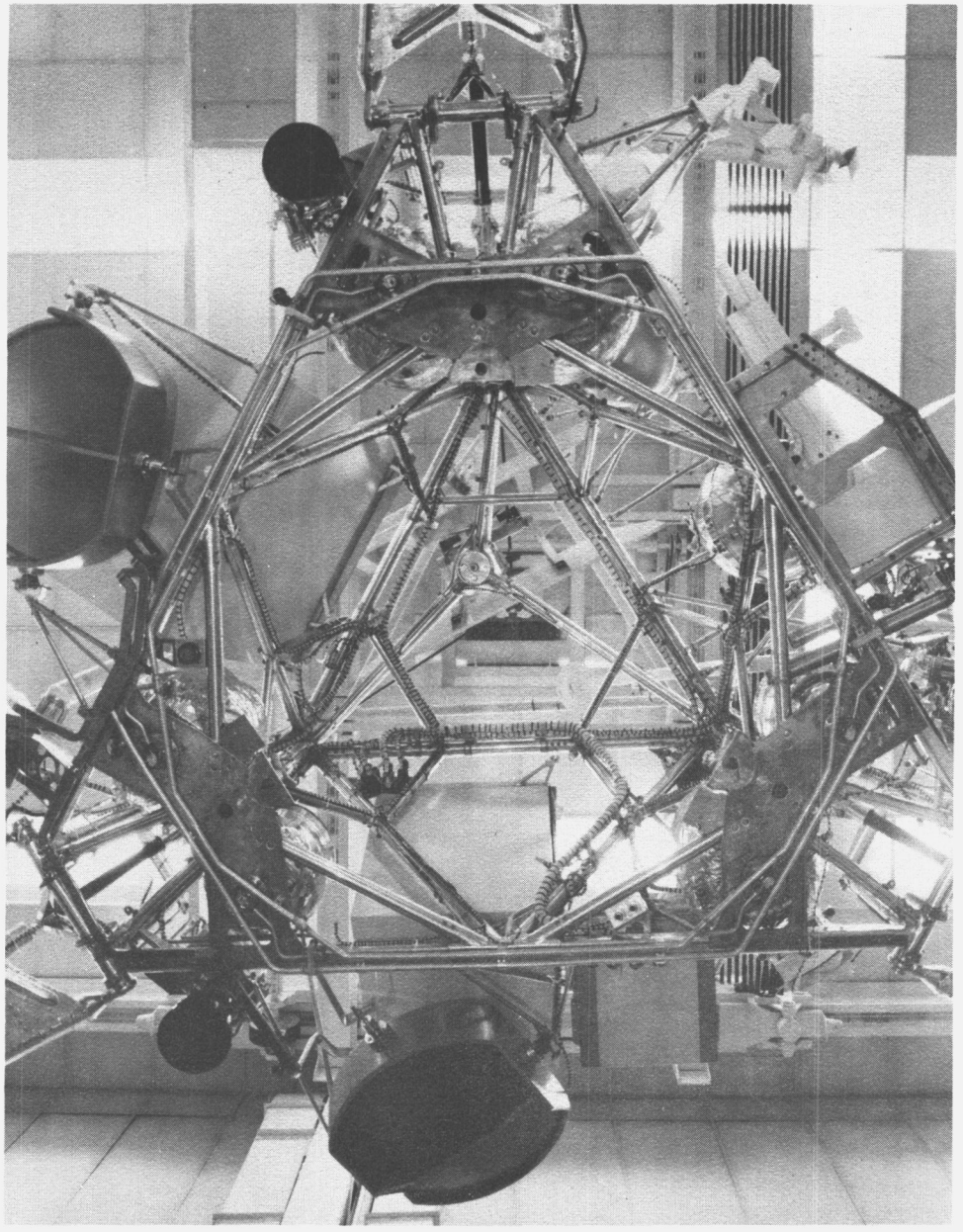
PERFORMANCE

THROAT INSERT

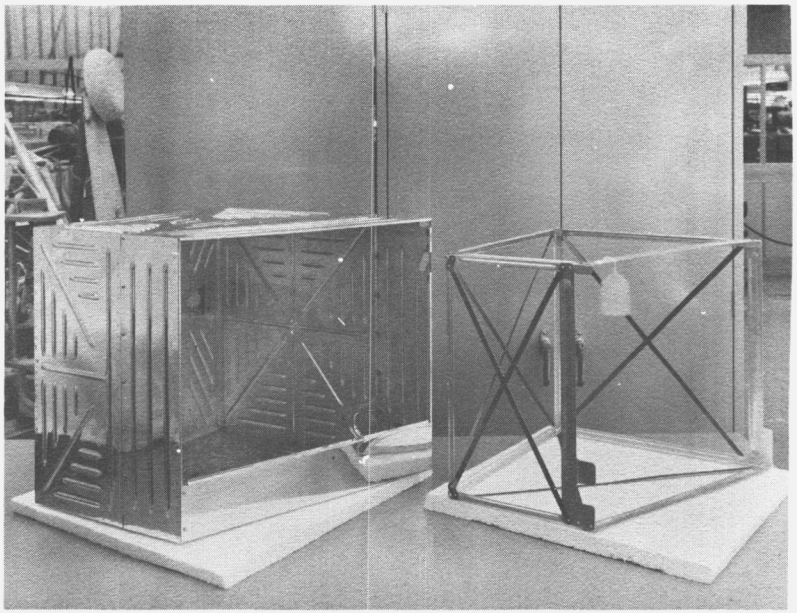
RETRO ENGINE FIRING PROGRAM



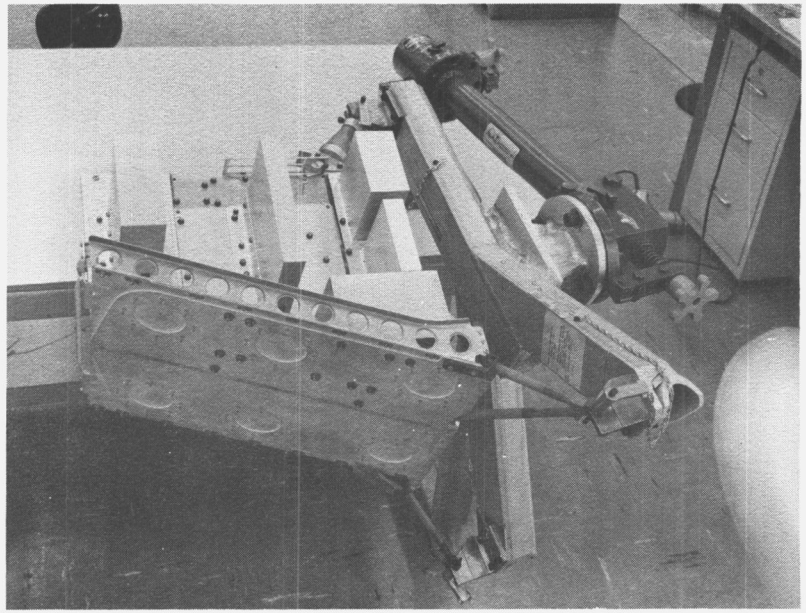
WIRING HARNESS ON M-12 MOCKUP



COMPARTMENT B HARDWARE



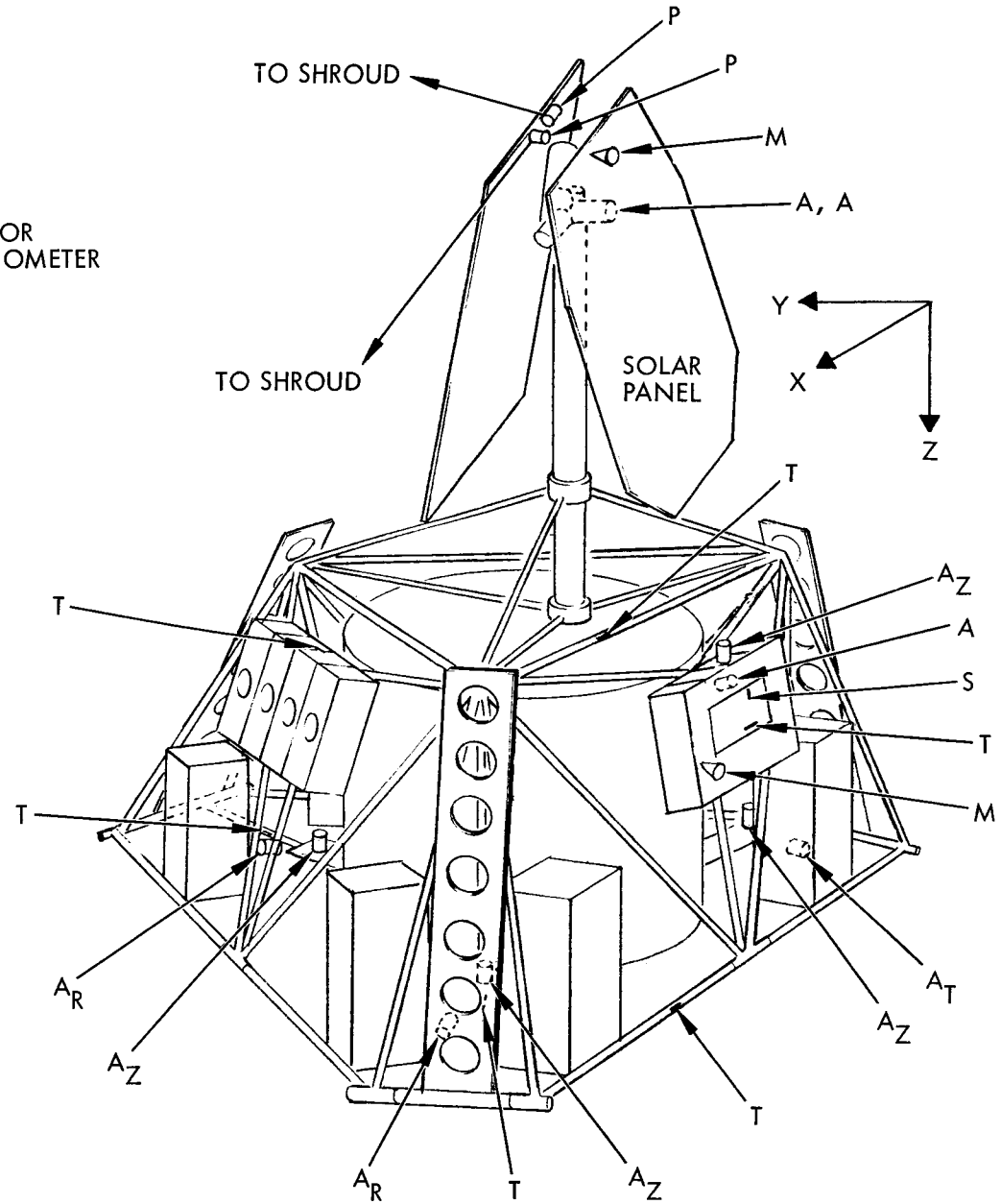
SHELL ASSEMBLY



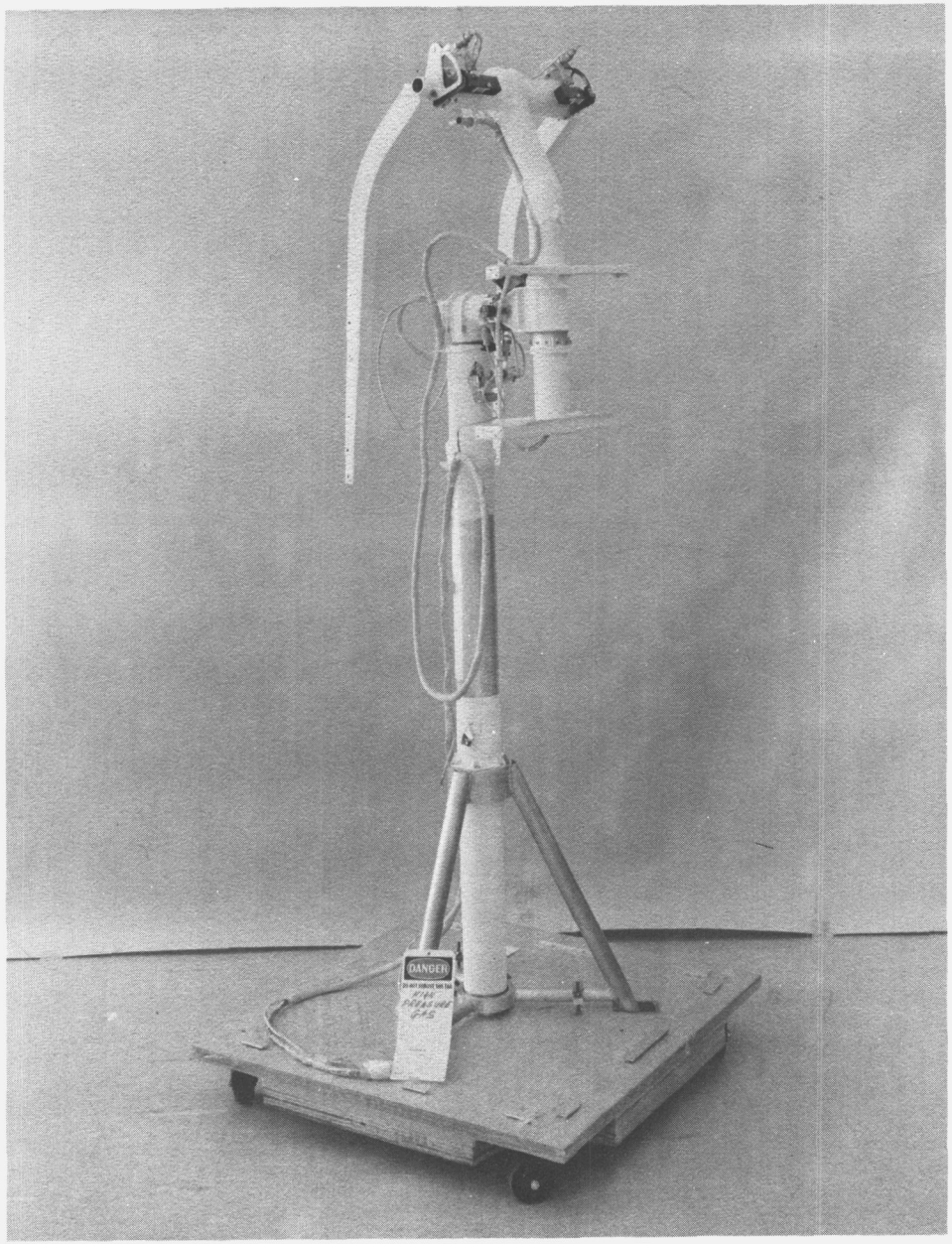
TRAY ASSEMBLY

DYNAMIC MODEL SD-4 CONFIGURATION

A = ACCELEROMETER
S = STRAIN GAGE
T = TEMPERATURE SENSOR
P = POSITION POTENTIOMETER
M = MICROPHONE

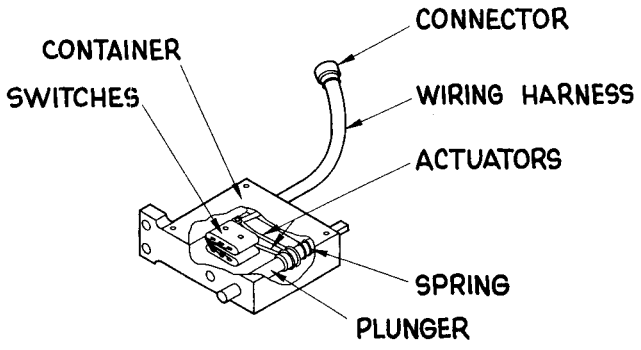


T-21 ANTENNA/SOLAR PANEL POSITIONER

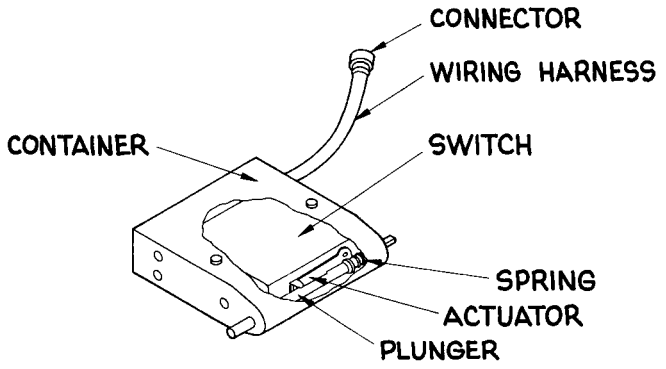


SEPARATION SENSING AND ARMING DEVICE

HUGHES
HUGHES AIRCRAFT COMPANY
SPACE SYSTEMS DIVISION



NEW DESIGN



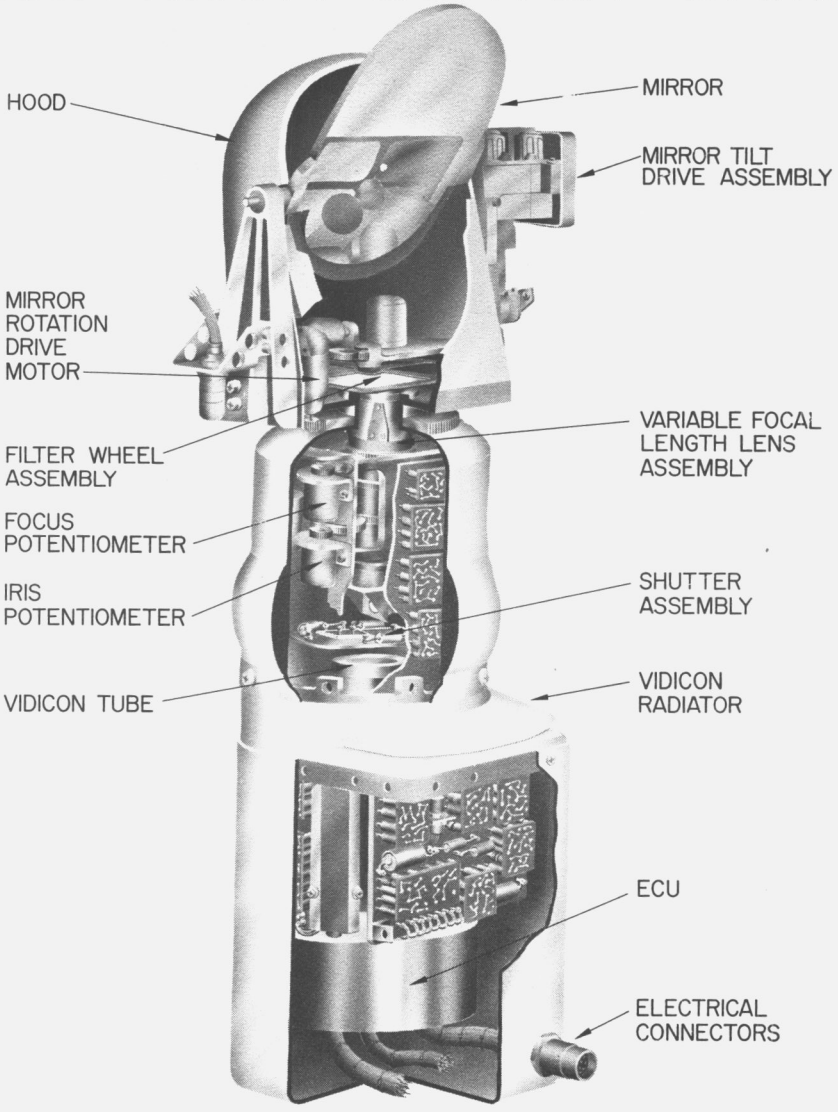
OLD DESIGN

ITEMS AFFECTING UNIT OPERATION

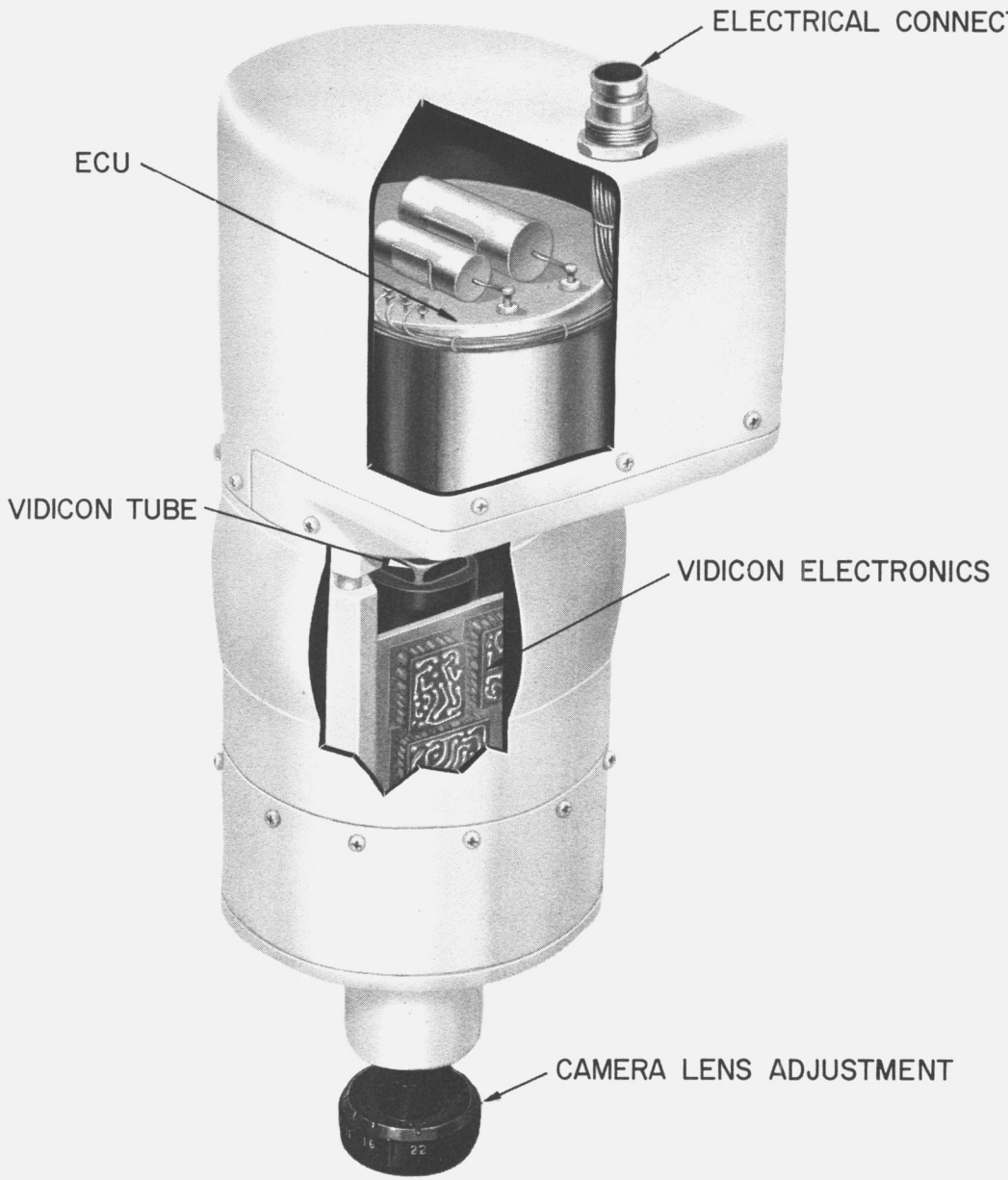
+ 0 lbs SIDE LOAD ON SHAFT EXERTED BY SWITCHES
+ CAPTIVE ACTUATORS
+ SWITCH ACTUATING FORCE 1 OZ. PER SWITCH
+ WEIGHT 0.2 lbs = 3.2 OZ. PER SS & A
+ RIGID MACHINED HOUSING, NEGLIGIBLE DEFLECTION AND CONTROLLABLE TOLERANCES
+ ACCESSABLE SWITCHES FOR ADJUSTMENT
+ NO SHAFT ORIENTATION REQUIRED FOR SWITCH ACTUATION
+ SURVEYOR QUALIFIED SWITCHES

- 2.0 ± 0.5 lbs SIDELOAD ON SHAFT EXERTED BY SWITCH
- FREE ACTUATOR
- WEIGHT 0.55 lbs = 8.8 OZ. PER SS & A
- SHEET METAL CONSTRUCTION WITH CORRESPONDING DEFLECTIONS AND TOLERANCES
- NON-ACCESSABLE SWITCHES FOR ADJUSTMENT
- SHAFT ORIENTATION REQUIRED FOR SWITCH ACTUATION

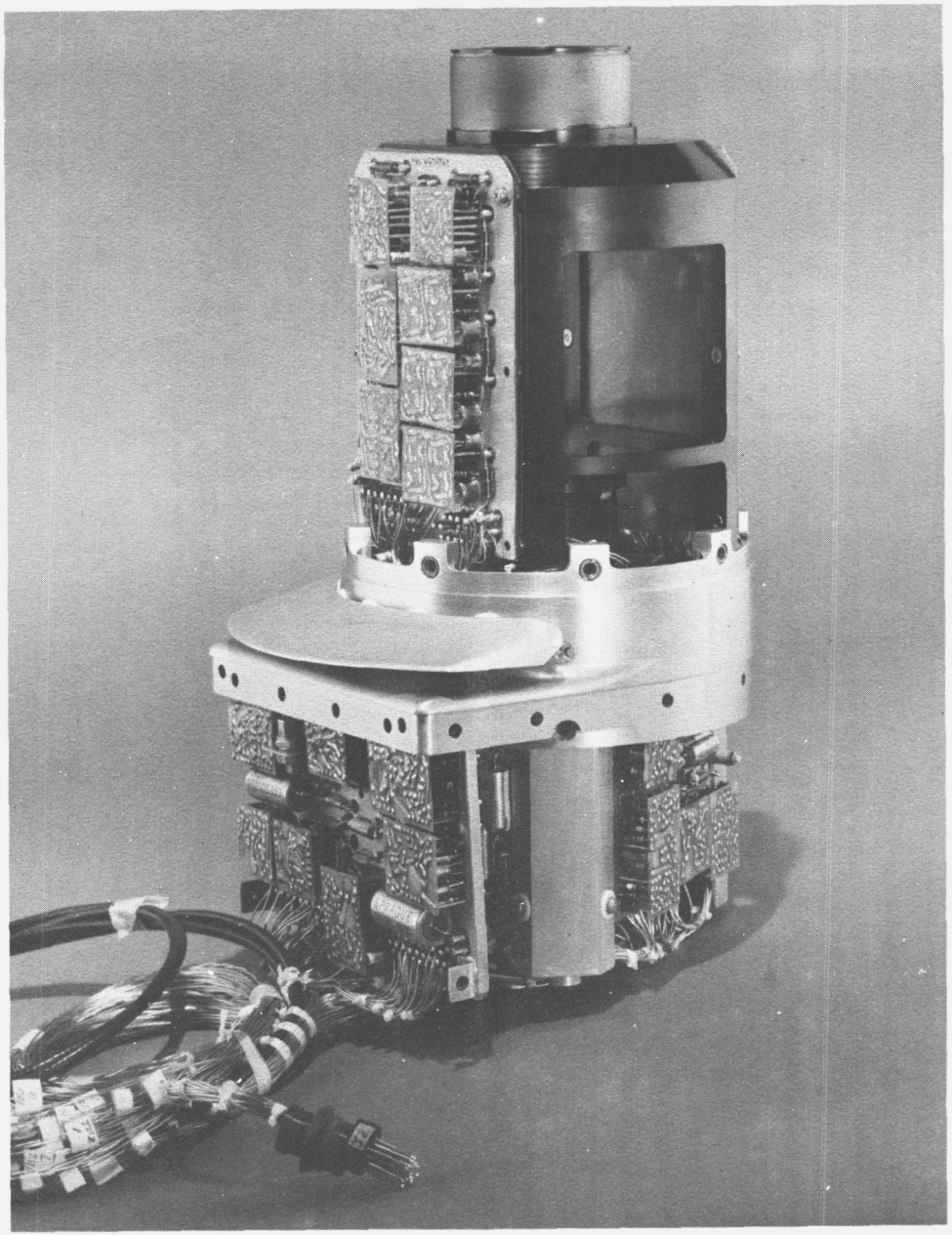
TELEVISION SURVEY CAMERA



TELEVISION APPROACH CAMERA SURVEYOR



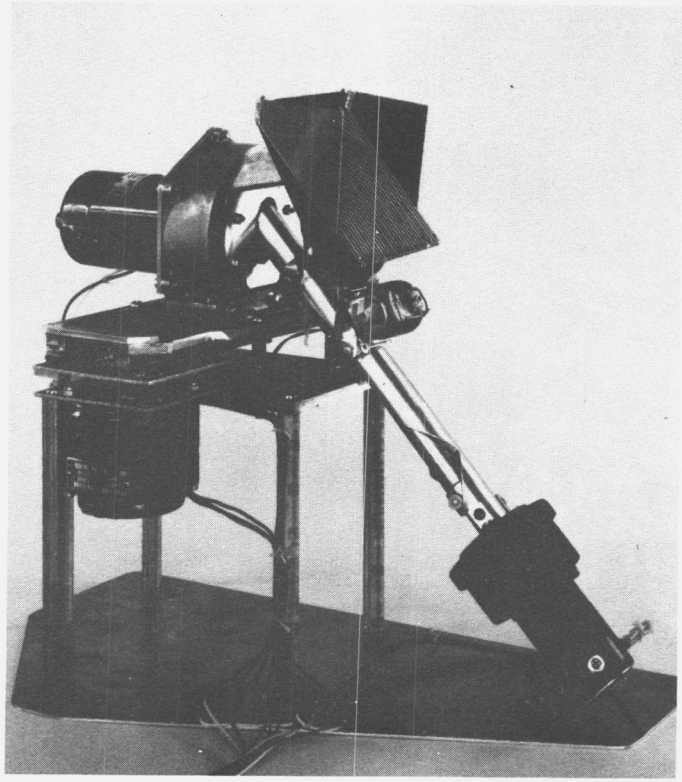
SURVEY CAMERA CONSTRUCTION



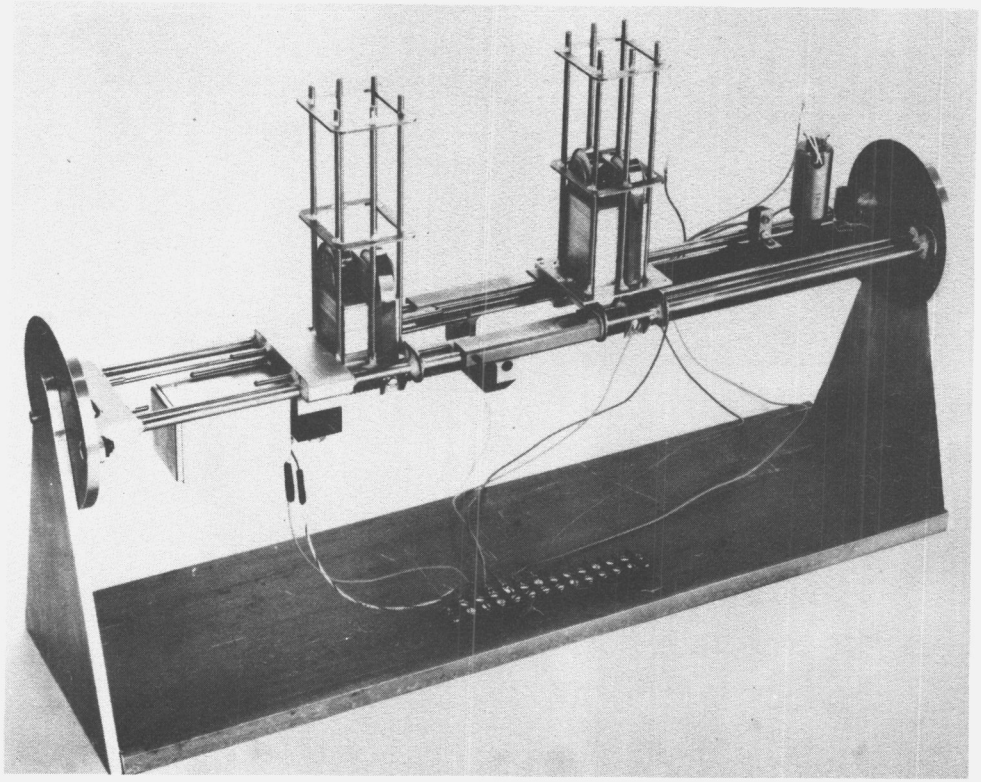
VIDICON COMPARISON, SELECTED SPECIFICATION PARAMETERS

	RCA	WESTINGHOUSE	GENERAL ELECTRIC CORPORATION
OPERATING TEMPERATURE LIMITS, °C	71 TO -190	45 TO -190	70 TO -190
VIDEO TO DARK SIGNAL RATIO, MIN.	0.9	15	25
RATIO OF LOG OUTPUT ENERGY TO LOG ILLUMINATION ENERGY, γ	0.5 - 0.8	0.7 - 1.3	0.8 - 1.2
CENTER RESOLUTION, PERCENT MINIMUM	30	40	60
CORNER RESOLUTION, PERCENT MINIMUM	30	25	40
TUBE NOISE, PERCENT MAXIMUM	5	1	1

SAMPLE PROCESSOR

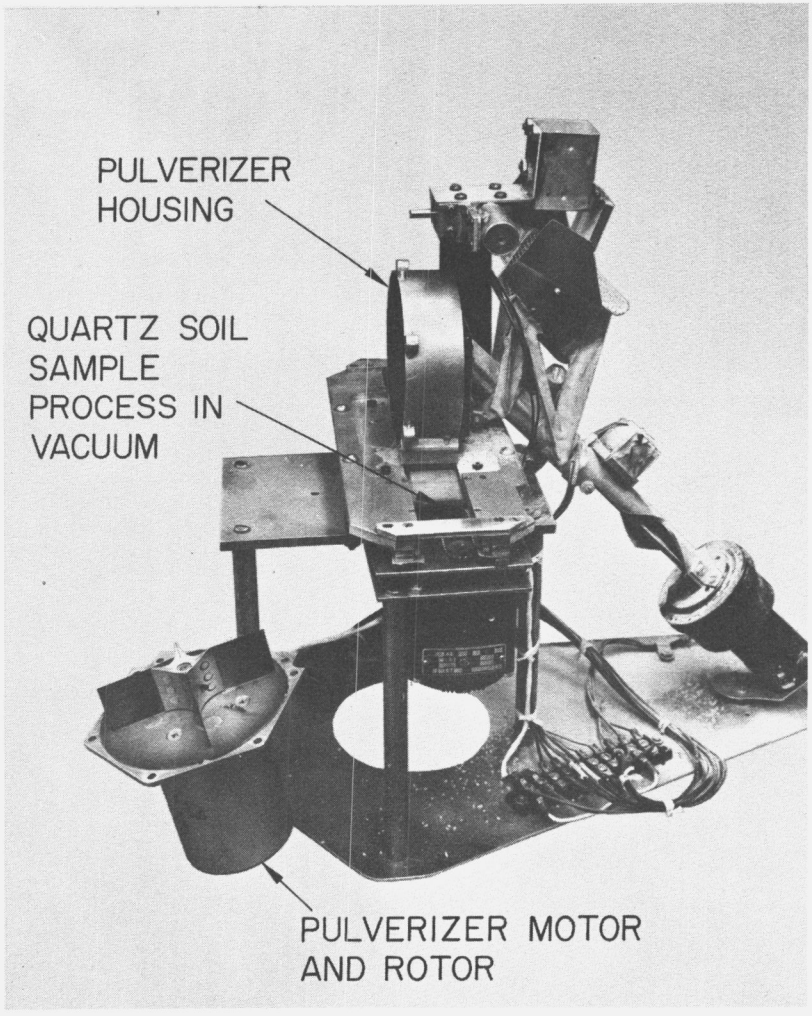


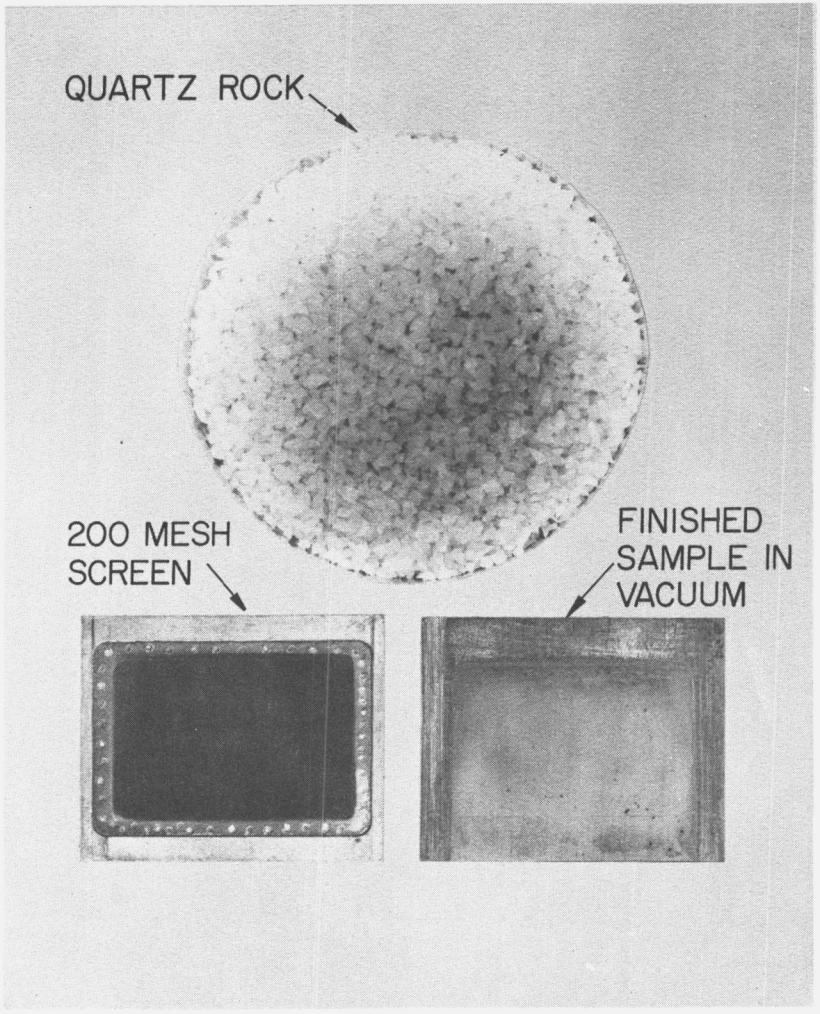
PULVERIZER
AND FEED



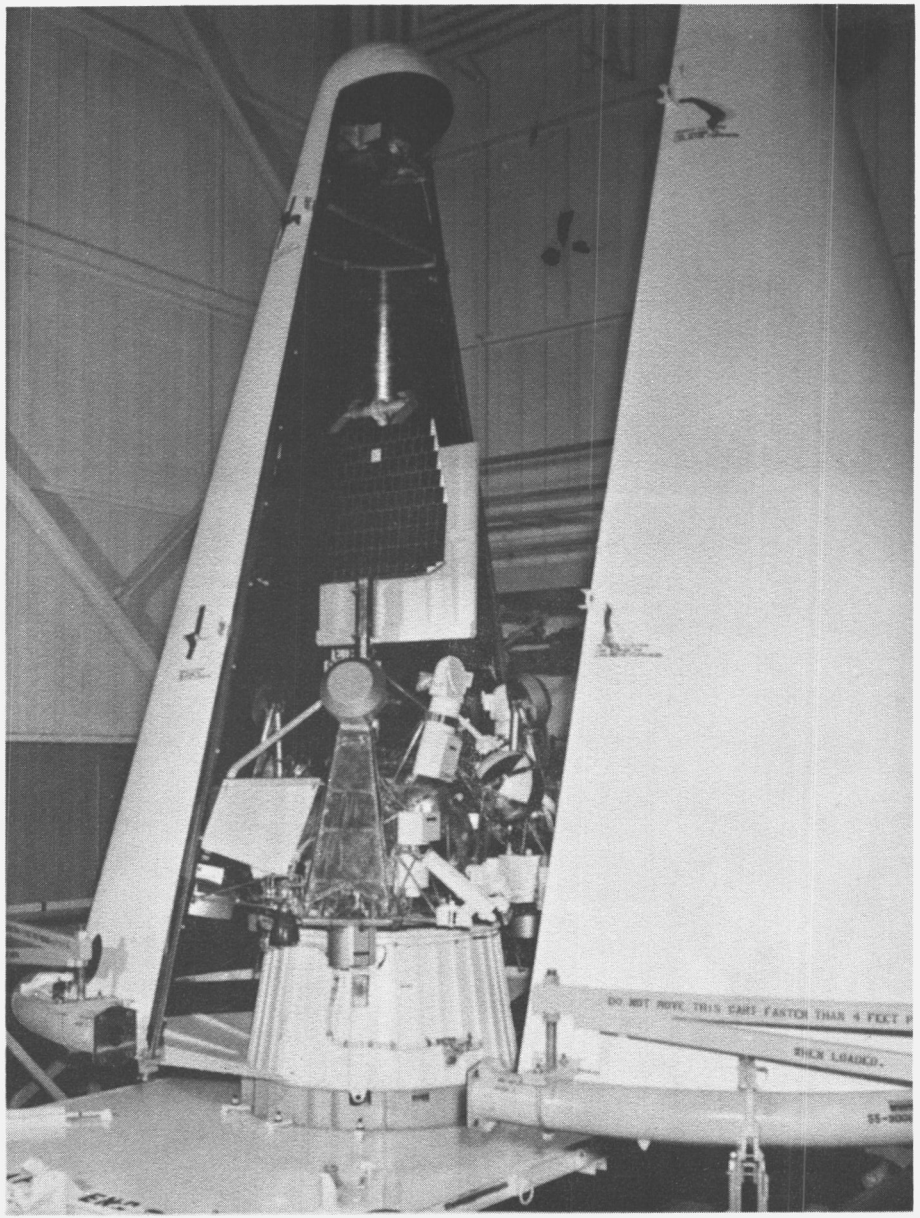
TRANSPORT

SOIL SAMPLE PROCESSING

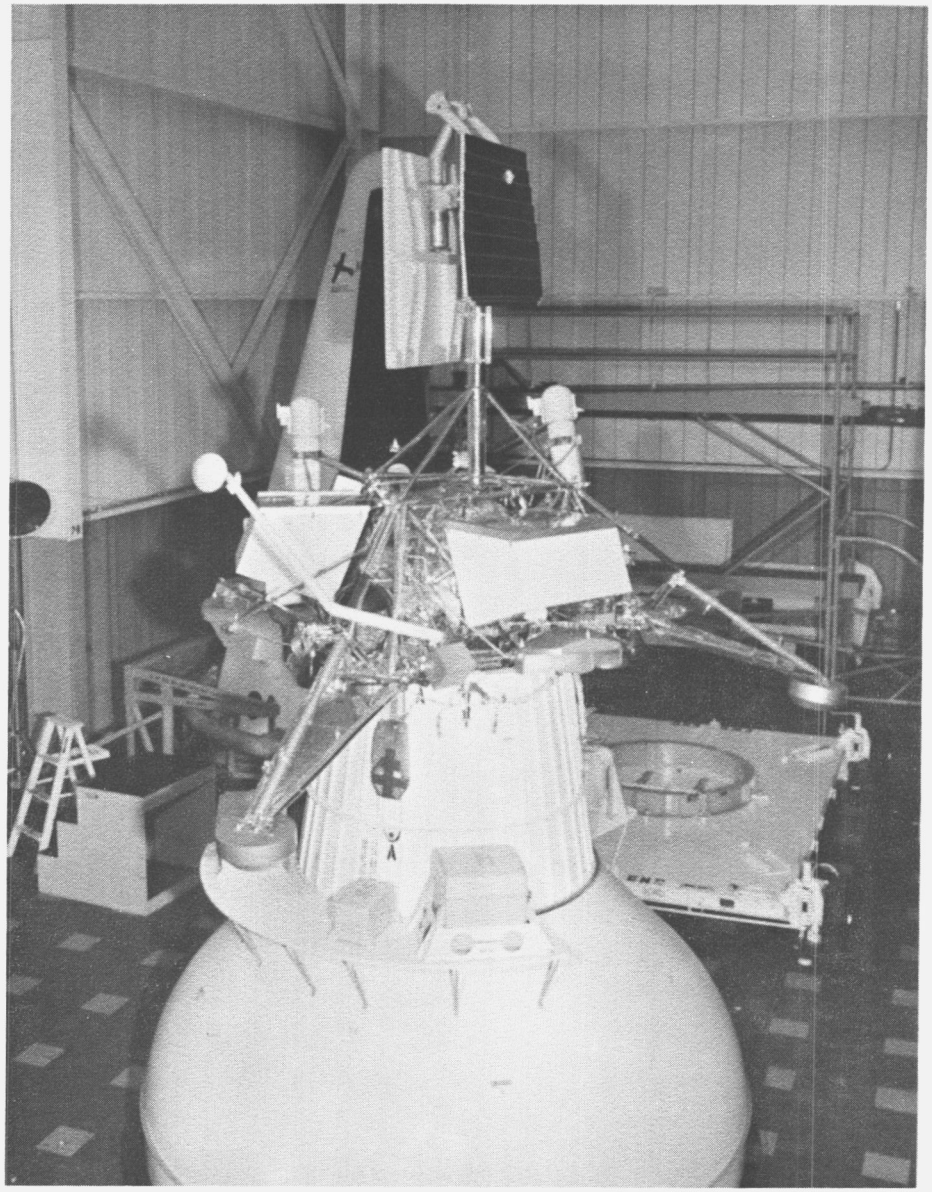




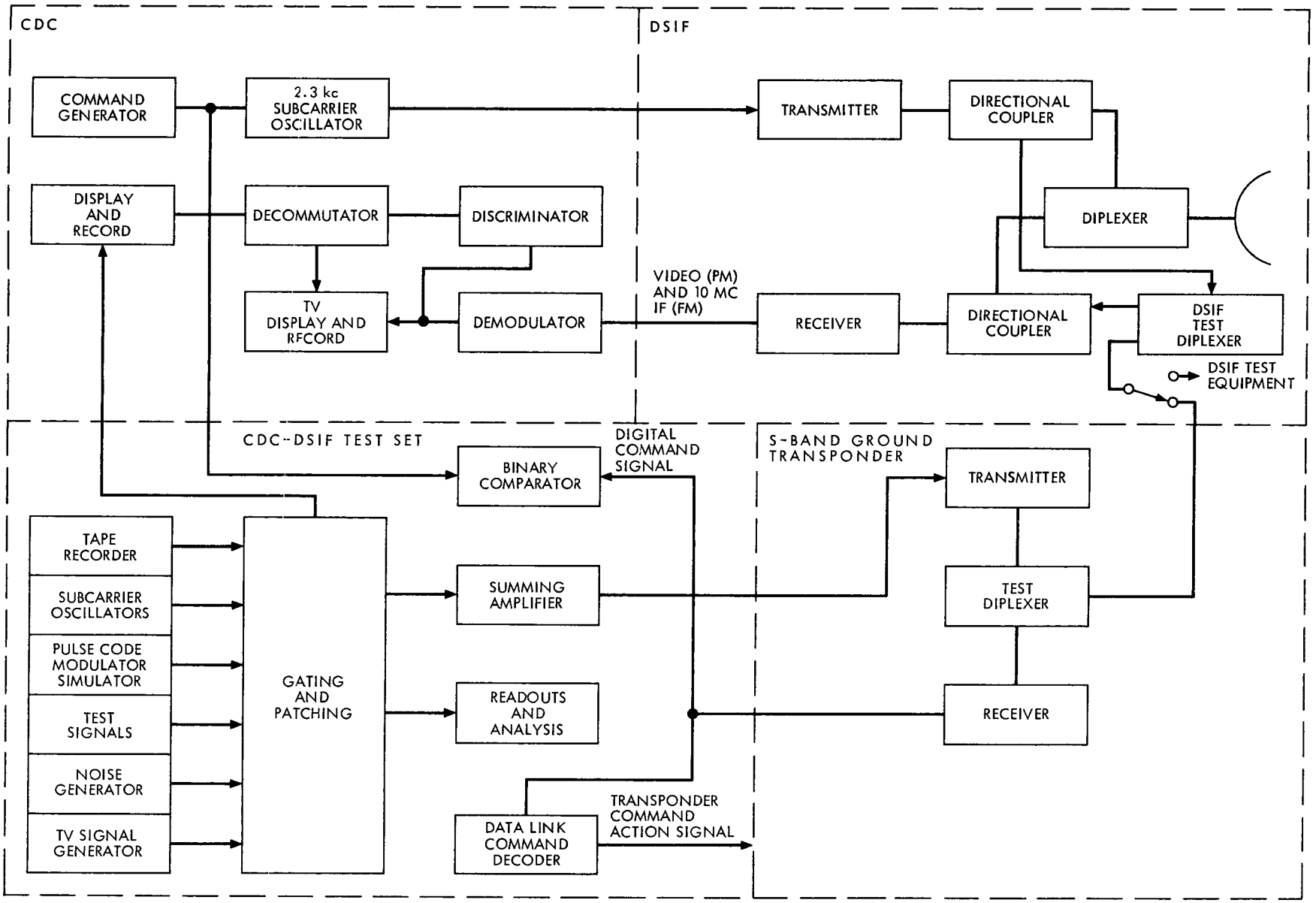
SPACECRAFT ENCAPSULATION IN CENTAUR MATCH-MATE TESTS



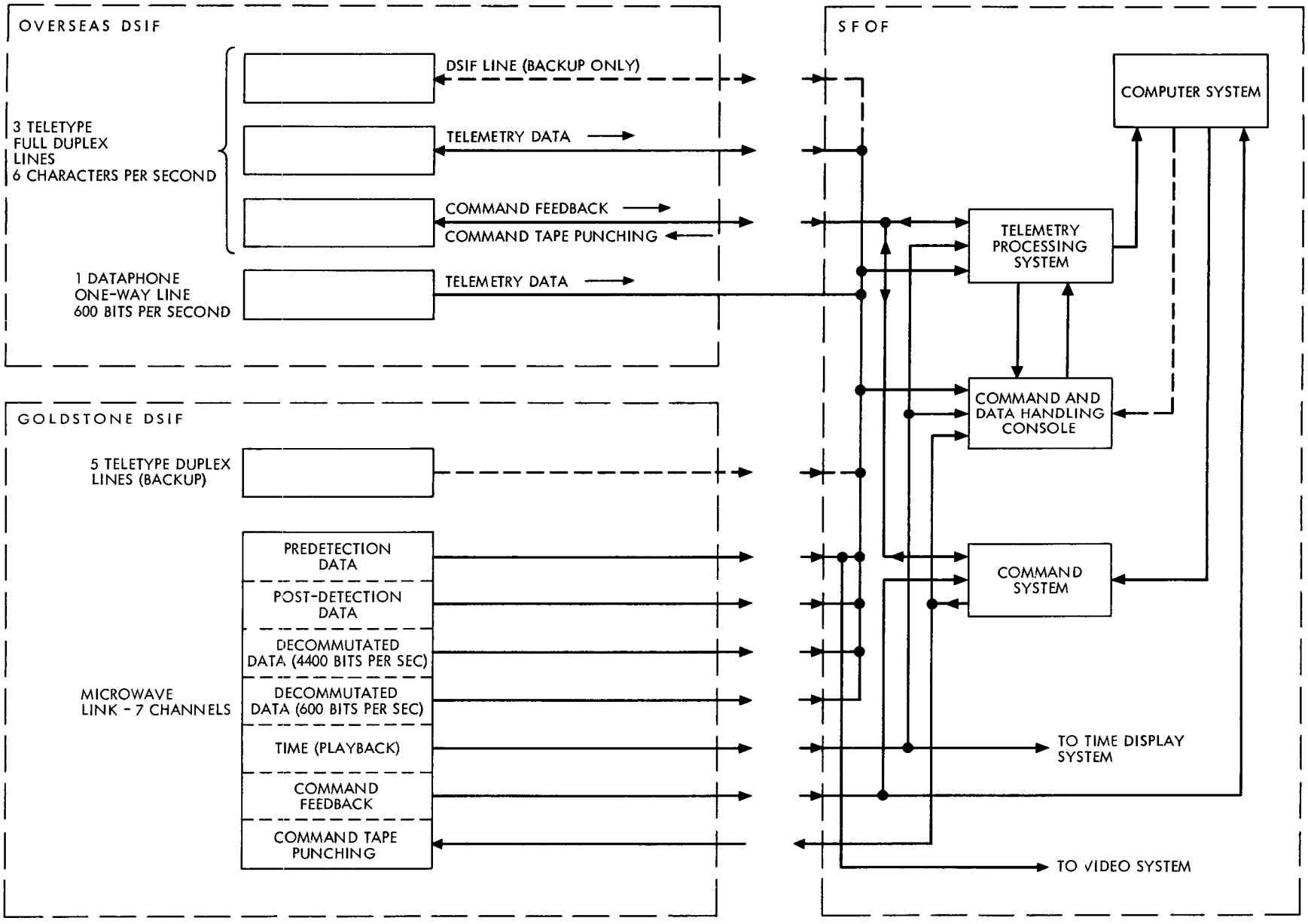
SPACECRAFT MOUNTED ON CENTAUR DOME IN MATCH-MATE TESTS



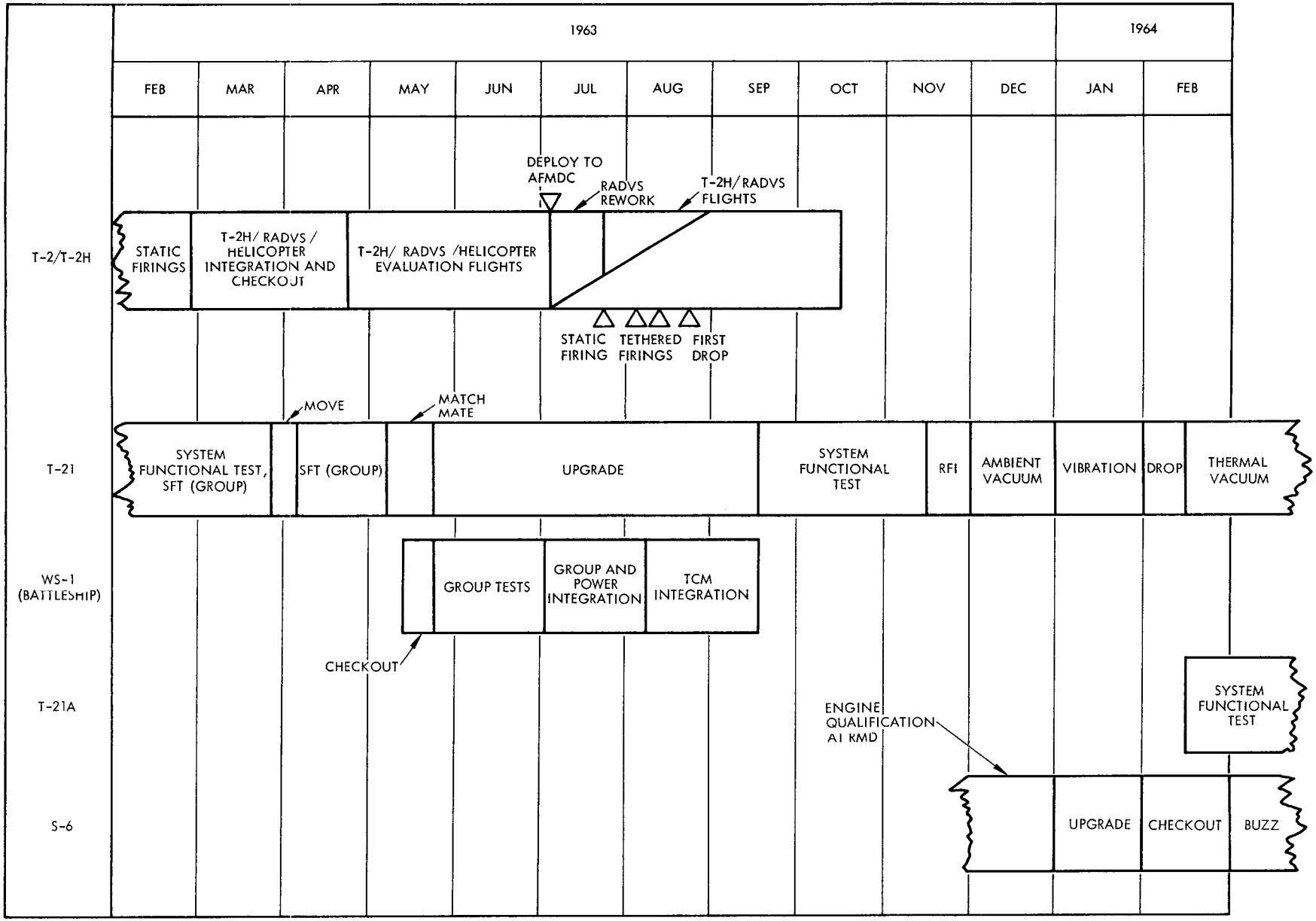
SPACECRAFT TEST SET



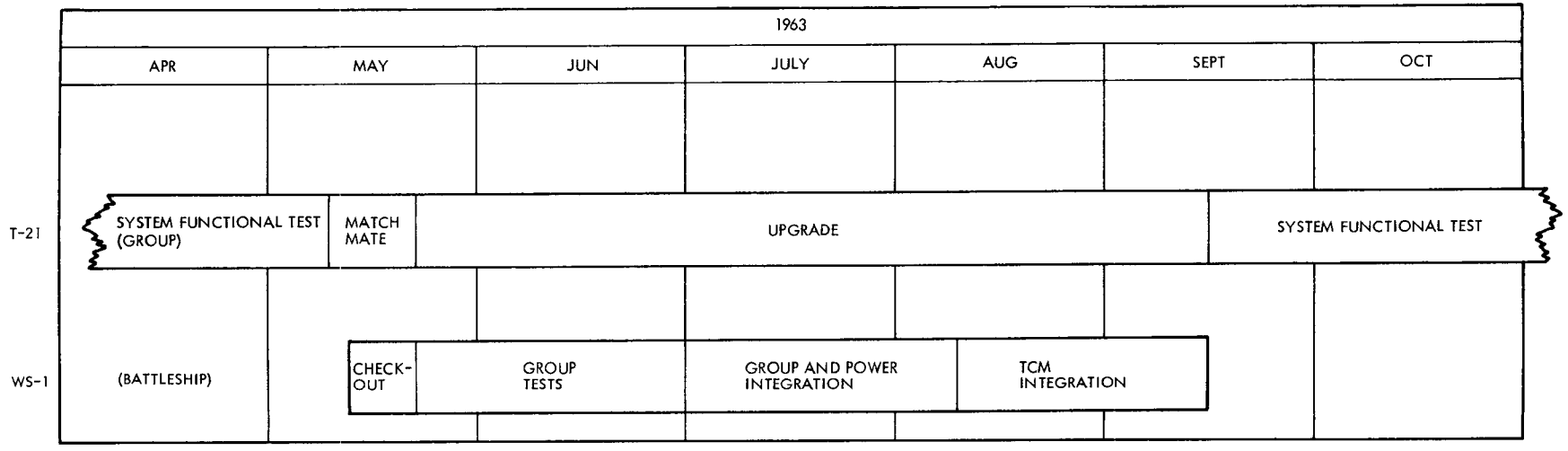
CDC / SFOF / DSIF SURVEYOR COMMUNICATION SYSTEM



SYSTEM TEST PROGRAM



T-21/WS-1 TEST PROGRAM

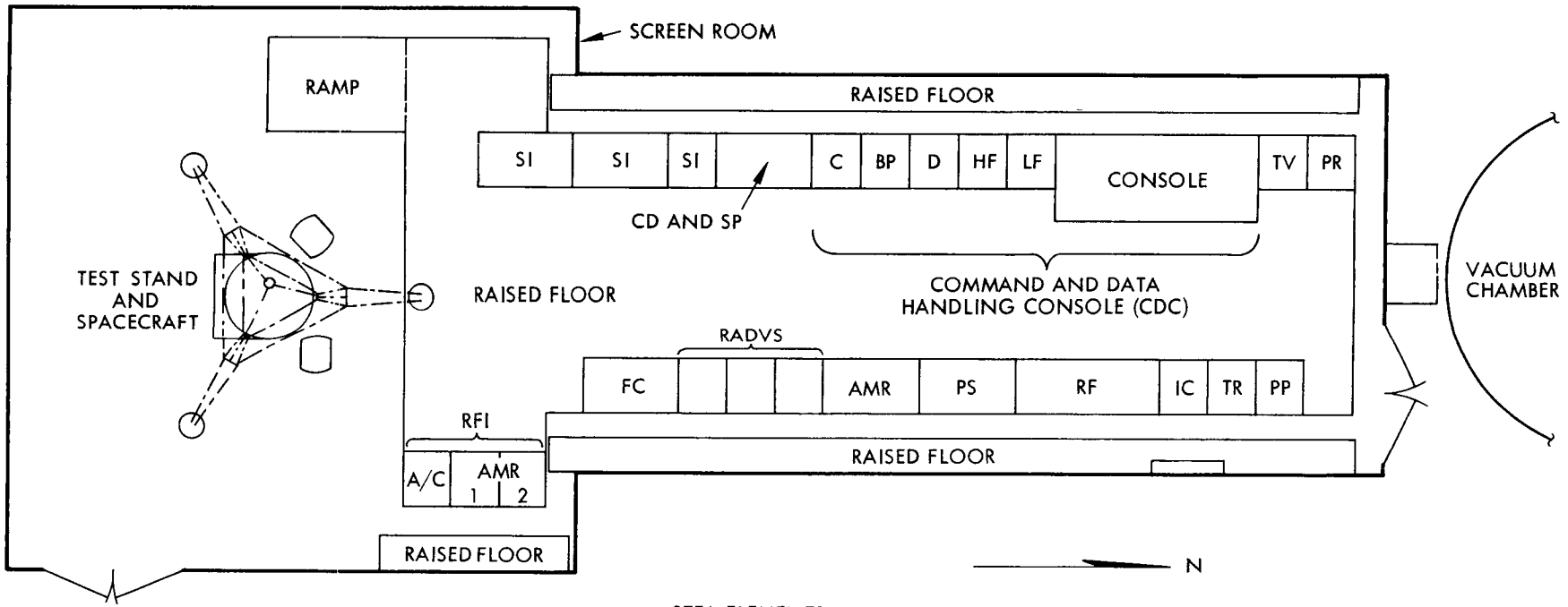


TESTS:

FLIGHT CONTROL	(FC)		FC - (RF - CD - SP - PO)
POWER	(PO)	RF - PO	TV - (RF - CD - SP - PO)
RECEIVER/TRANSMITTER	(RF)	CD - PO	
		CD/SP - PO	
SIGNAL PROCESSING	(SP)	TV - PO	
COMMAND DECODING	(CD)	FC - PO	
		RF - CD - SP - PO	
PROBLEM INVESTIGATION:			
COMMAND LINE NOISE SENSOR		COMMAND LINE NOISE SENSOR	COMMAND LINE NOISE SENSOR
TRANSMITTER FILTER ECU TURN-OFF		TRANSMITTER FILTER ECU TURN-OFF	
SPURIOUS TRANSMITTER MODULATION		SPURIOUS TRANSMITTER MODULATION	
RF SWITCH CHATTER		RF SWITCH CHATTER	
LOW GYRO LOOK ANGLE		LOW GYRO LOOK ANGLE	
		TV COMMAND INTERACTION	TV COMMAND INTERACTION
		IMPROPER CDU INDEXING	IMPROPER CDU INDEXING
		TRANSMITTER FREQUENCY DEVIATION	TRANSMITTER FREQUENCY DEVIATION
		EFFECTS OF ECU NOISE (TV)	EFFECTS OF ECU NOISE (TV)
		SPURIOUS FRAME ENABLE	
		LOW HORIZONTAL RESOLUTION	
		LACK OF CONTRAST	
		TV AUXILIARY TURN-OFF	
		DARK CURRENT ADJUSTMENT	

SYSTEM TEST AREA

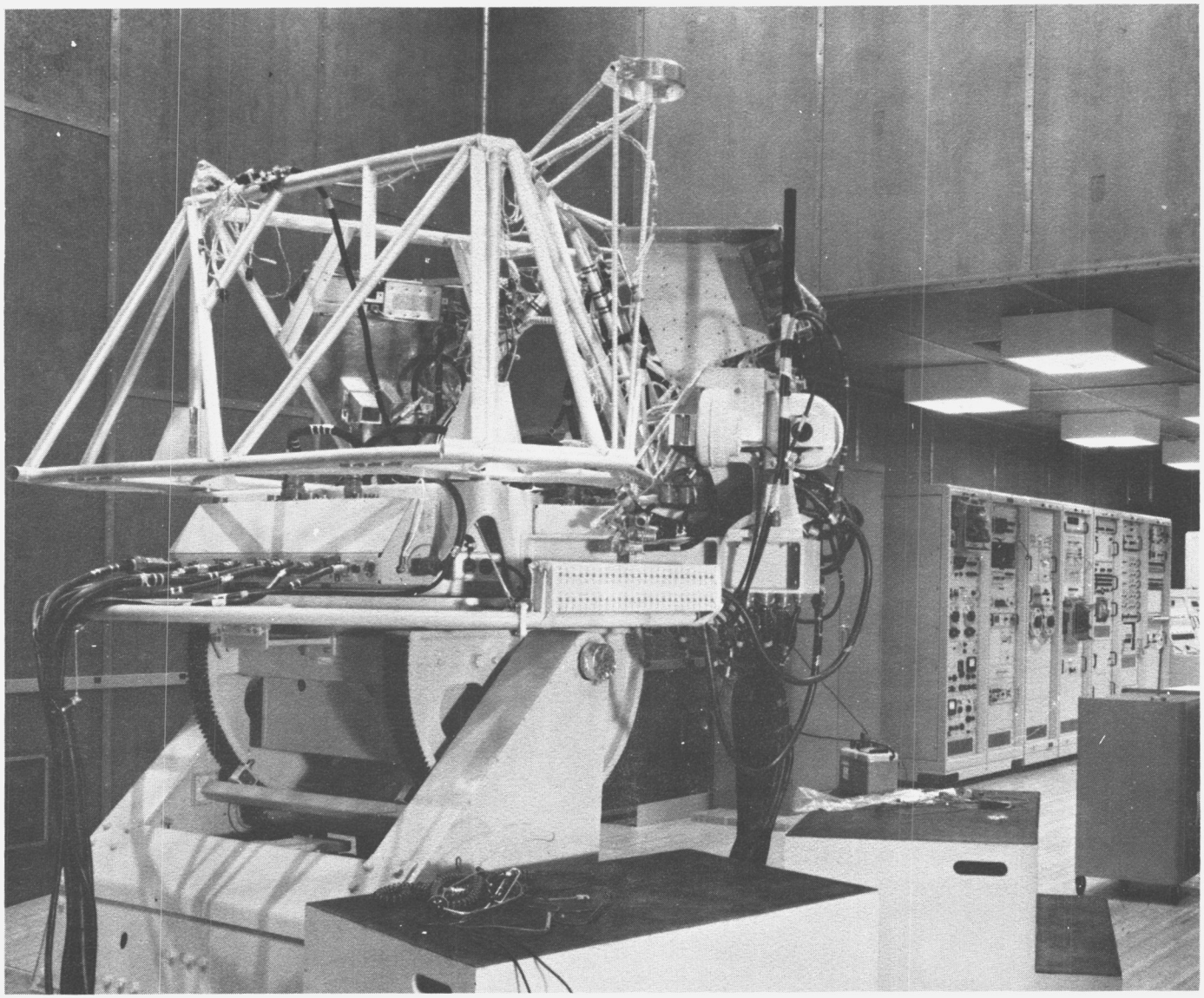
HUGHES SPACE ENVIRONMENT SIMULATION LABORATORY



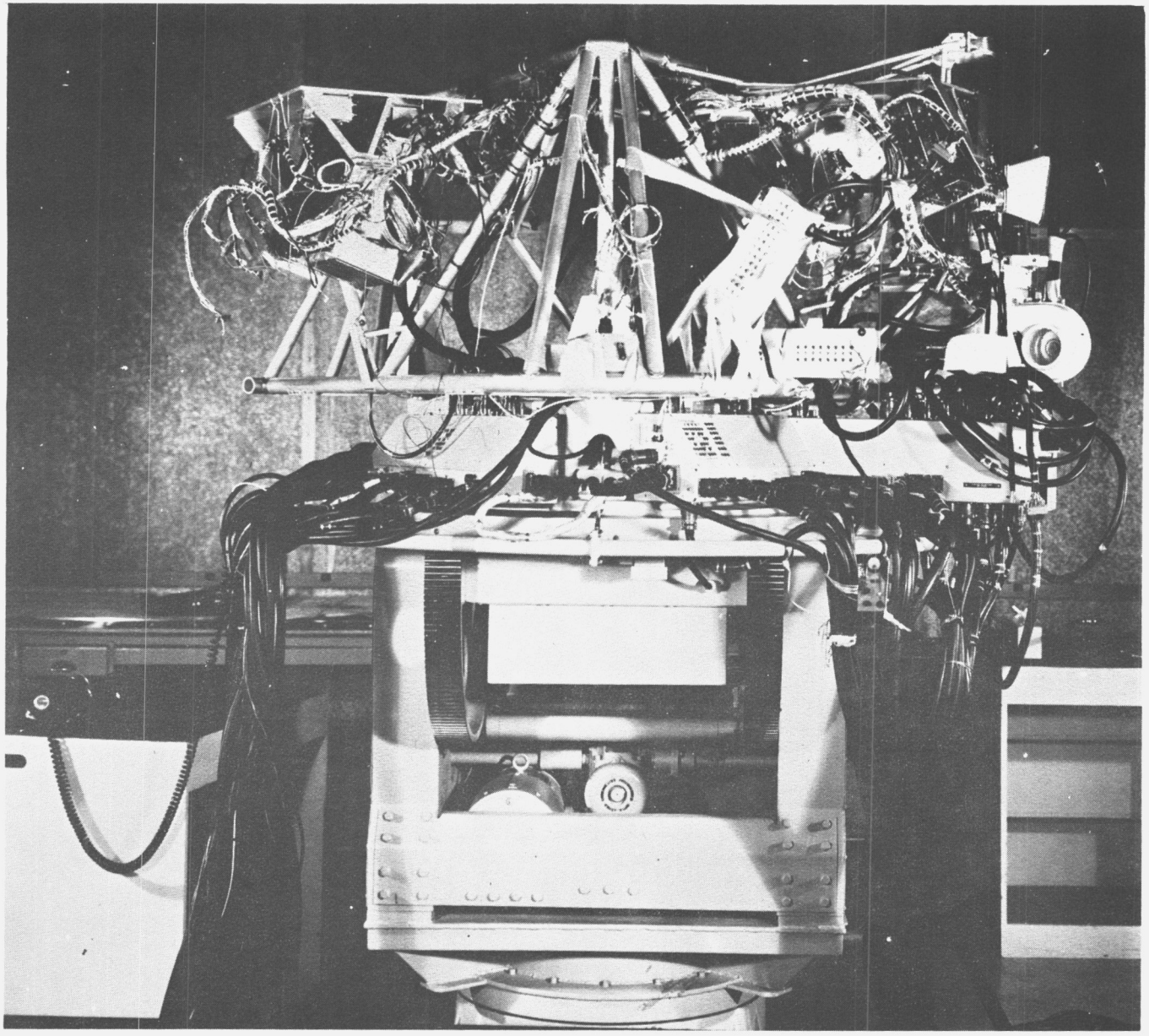
STEA ELEMENTS

SI - SCIENTIFIC INSTRUMENTS
CD AND SP - COMMAND DECODER AND SIGNAL PROCESSOR
C - COMMAND
BP - BUFFER AND PATCH
D - DECOMMUTATOR
PP - PRELAUNCH POWER
TR - CDC TAPE RECORDER
A/C - ATLAS/CENTAUR
IC - INTERCOMMUNICATIONS
HF - HF OSCILLATOR AND DISCRIMINATOR
LF - LF OSCILLATOR AND DEMODULATOR
PR - CDC PHOTORECORDER
FC - FLIGHT CONTROL
AMR - ALTITUDE MARKING RADAR
PS - POWER SUPPLY

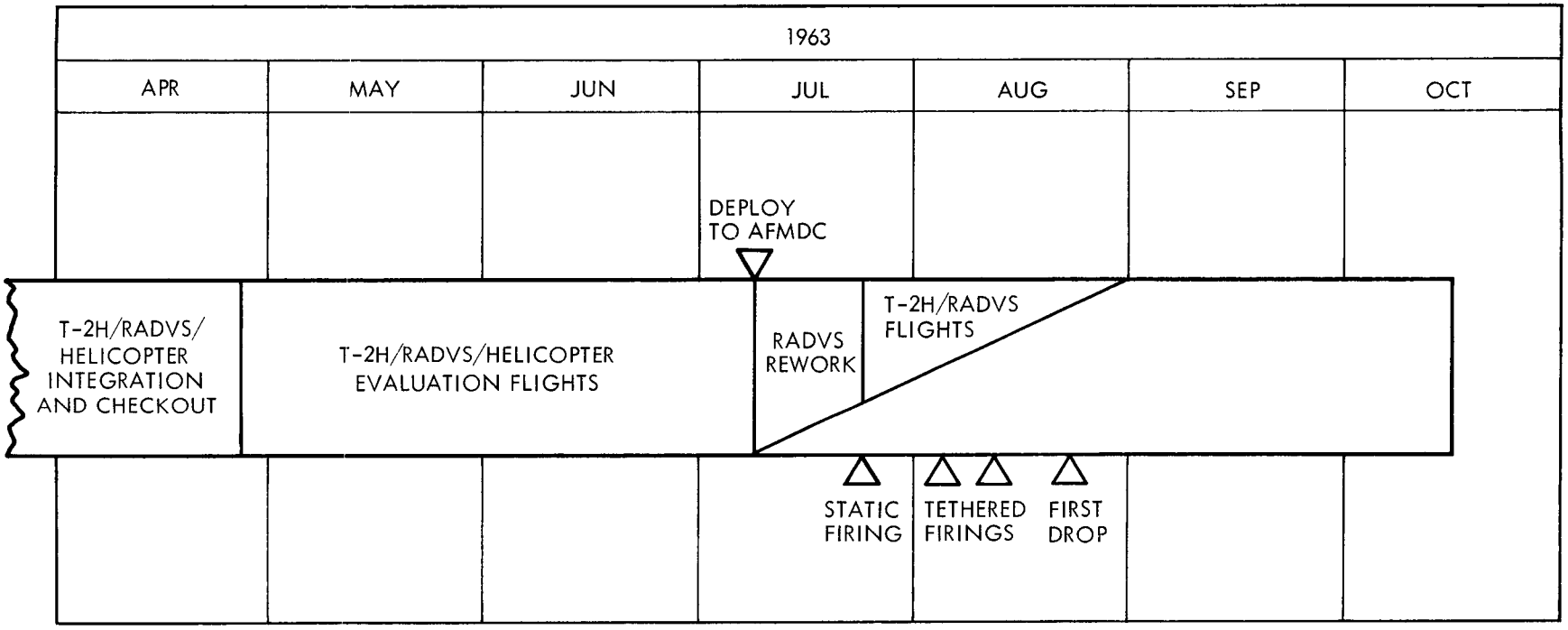
WS-1 TEST FIXTURE IN SYSTEM TEST AREA



TESTING OF T-21 SUBSYSTEMS ON WS-1 TEST FIXTURE



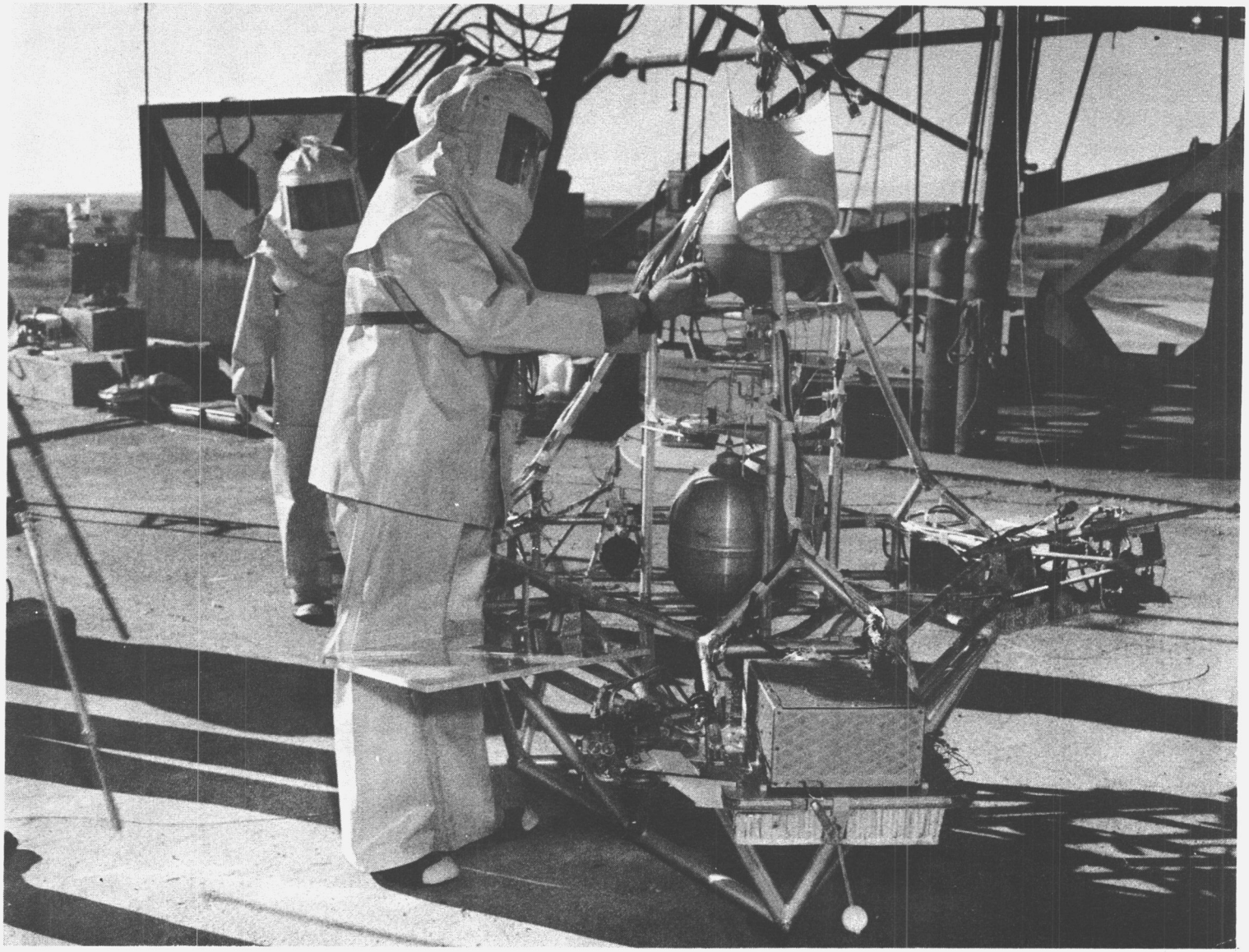
T-2/T-2H TEST PROGRAM



	FLIGHT RECORD	
	FLIGHTS	DATA ACQUISITION, PERCENT
VIBRATION	4	100
RADVS	16	56

AFMDC TEST PLANS	
T-2H/RADVS/HELICOPTER FLIGHTS	12
VERNIER ENGINE STATIC FIRINGS	1
VERNIER ENGINE TETHERED FIRINGS	2
BALLOON DROPS	9

PREPARATION OF T-2 FOR TEST



TESTING OF RADVS SYSTEM ON T-2H TEST VEHICLE

T-2 PROBLEM SUMMARY

ITEM	SOLUTION
VERNIER ENGINES	
● THROTTLE VALVE HYSTERESIS	O NEW THROTTLE VALVE DEVELOPED - SYSTEM TESTING IN PROCESS
● UNSCHEDULED THRUST TRANSIENT	● LOADING PROCEDURE REVISED
● ROUGH ENGINE RE-START	O UNDER INVESTIGATION
● HELIUM REGULATOR LOCK-UP FAILURE	O REDESIGNED REGULATOR - SYSTEM TESTING IN PROCESS
RADVS	
● RODVS* PRESENT PRIOR TO STABLE V_x, V_y, V_z	● TIME CONSTANT CHANGED
● RANDOM PERTURBATIONS, V_x, V_y, V_z	● SDC INTERNAL COUPLING CHANGED
● 13 ft MARK UNRELIABLE	O UNDER INVESTIGATION
● RA KLYSTRON INTERMITTENT	● DIODE ADDED TO KLYSTRON CONTROL
● KPSM TIME-IN ERRATIC	O TIMING CIRCUITRY MODIFIED
● SYSTEM TIME CONSTANT LONG	● CIRCUITRY MODIFIED
● RADAR OUTPUT NOISY	O UNDER INVESTIGATION
● RANGE QUANTIZATION	O UNDER INVESTIGATION - APPEARS TO BE NO PROBLEM FOR T-2
● BREAK-LOCK AT GAIN SWITCH	O UNDER INVESTIGATION
● RODVS* PRESENT AFTER BREAK-LOCK	O MEMORY TIME REDUCED
● CIRCUIT BOARD FABRICATION SUBSTANDARD	O REWORK OF BOARDS BY VENDOR
● SDC LOW VOLTAGE POWER SUPPLY UNRELIABLE	O PRESENT MODULE REWORKED - PARALLEL IN-HOUSE REDESIGN

*RELIABLE OPERATE DOPPLER VELOCITY SENSOR

● = PROBLEM SOLVED

O = FURTHER TESTING NEEDED